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AUSTROBAILEYA

A Journal of Plant Systematics
and
Conservation Biology

Queensland Herbarium
Department of Science, Information Technology, Innovation and the Arts

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A taxonomic revision of *Diospyros* L. (Ebenaceae) in Australia

L.W. Jessup

Summary

Jessup, L.W. (2014). A taxonomic revision of *Diospyros* L. (Ebenaceae) in Australia. ***Austrobaileya* 9(2): 155–197**. The Australian taxa of the genus *Diospyros* are revised. Twenty two species (21 native and 1 naturalised) are recognised. Six species are described as new: *Diospyros granitica* Jessup, *D. peninsularis* Jessup, *D. pluviatilis* Jessup, *D. rheophila* Jessup, *D. uvida* Jessup and *D. yandina* Jessup and new combinations are made for *D. hemicycloides* (F.Muell. ex Benth.) Jessup (based on *Maba hemicycloides* F.Muell. ex Benth) and *D. laurina* (R.Br.) Jessup (based on *Maba laurina* R.Br.). Descriptions, distribution maps, illustrations and identification keys based on male or female material are provided.

Key Words: Ebenaceae, *Diospyros*, *Diospyros areolifolia*, *Diospyros australis*, *Diospyros calycantha*, *Diospyros compacta*, *Diospyros fasciculosa*, *Diospyros geminata*, *Diospyros granitica*, *Diospyros hebecarpa*, *Diospyros hemicycloides*, *Diospyros humilis*, *Diospyros kaki*, *Diospyros laurina*, *Diospyros littorea*, *Diospyros mabacea*, *Diospyros maritima*, *Diospyros peninsularis*, *Diospyros pentamera*, *Diospyros pluviatilis*, *Diospyros rheophila*, *Diospyros rugosula*, *Diospyros uvida*, *Diospyros yandina*, Australia flora, taxonomy, new species, identification key, distribution maps

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Introduction

Diospyros L. is a pantropical and subtropical genus of over 500 species (Frodin 2004; Wallnőfer 2001, 2004). Robert Brown (1810) was the first to describe Australian species under the genera *Diospyros* L., *Maba* J.R.Forst. & G.Forst. and *Cargillia* R.Br. Bentham (1868) continued to recognise these three genera although Mueller (1867) had transferred several species described by Brown and himself under *Maba* and *Cargillia* to *Diospyros*. Hiern (1873) and Bailey (1900) continued to recognise the genus *Maba* but not *Cargillia*. Bakhuizen van den Brink (1936–1955) produced a multilevel classification of *Diospyros* recognising *Maba* and *Cargillia* as subgenera along with three other subgenera not represented in Australia. He also placed several Australian species under the large *D. ferrea* (Willd.) Bakh. group of taxa. Kostermans (1977) considered *D. ferrea* to be confined to India and Ceylon (Sri Lanka) and reinstated several Australian taxa to species under *Diospyros*. Smith (1981) followed Kostermans and rejected the broad concept of *D. ferrea* in his treatment of *Diospyros* in Fiji.

Attempts at infrageneric classification since Bakhuizen van den Brink (1936–1955) have been proposed by White (1980) and Singh (2005) but molecular studies of Duangjai *et al.* (2006, 2009) reveal 11 well-resolved major clades in *Diospyros* and indicate that all earlier infra-generic classifications are artificial. The authors acknowledge that although their study is the most extensive to date for *Diospyros*, the sampling is still too limited to propose with confidence a new infrageneric classification.

Materials and methods

This revision is based on herbarium collections in BM, BRI, CANB, CNS (previously QRS), E, K, L, MEL and NSW and some field observations by the author. All specimens cited have been seen by the author. Descriptions of flowers were prepared from material preserved in FAA or 70% alcohol and glycerol or reconstituted by briefly boiling in water. The descriptions of fruit were prepared from both dried and alcohol preserved material. Common abbreviations in the specimen citations are FR (Forest Reserve),

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LA (Logging Area), NP/NPR (National Park/ National Park Reserve), R (Reserve), SFR/ SF (State Forest Reserve/State Forest), TR (Timber Reserve). Electronic images of type specimens at the JSTOR website are indicated as "online image!".

Taxonomy

Diospyros L., *Sp. Pl.* 1057 (1753). **Type species:** *Diospyros lotus* L. (lecto: *fide* Britton & Brown 1913: 720).

Maba J.R.Forst. & G.Forst., *Char. Gen. Pl.* 61, t. 61 (1775); ed. 2: 121, t. 61 (1776); ed. 3: 61, t.61 (1776); *Diospyros* L. section *Maba* (J.R.Forst. & G.Forst.) Hiern (as section *Ferreola nom. illegit.*); section *Maba* (J.R.Forst. & G.Forst.) Singh, *Monogr. on Indian Diospyros (Persimmon, Ebony) Ebenaceae* 23 (2005), *comb. superfl.* **Type species:** *Maba elliptica* J.R.Forst. & G.Forst.

Cargillia R.Br., *Prodr.* 526 (1810); *Diospyros* section *Cargillia* Hiern, *Trans. Cambridge Philos. Soc.* 12: 146, 155 (1873). **Type species:** *Diospyros cargillia* F.Muell. *nom. inval. nom. nud.*

Diospyros subgenus *Cargillia* (R.Br.) Bakh., *Gard. Bull. Straits Settlem.* 7: 162 (1933). **Type species:** not designated.

Trees or shrubs, commonly dioecious, rarely monoecious, andromonoecious or polygamomonoecious. Indumentum of simple hairs or 2-armed with one arm very short (submedifixed). Wood commonly hard and dark, latex absent. Leaves simple, alternate, usually distichous, entire, often with nectaries on underside, petiolate, exstipulate. Inflorescence axillary, determinate, cymose in males, often solitary flowers in females. Flowers actinomorphic, hypogynous, unisexual, bracteate. Staminate flowers with vestigial ovary. Pistillate flowers with or without staminodes. Calyx gamosepalous, persistent, often accrescent in fruit, 3–6-lobed, lobes valvate. Corolla gamopetalous, 3–6-lobed, lobes imbricate or contorted. Stamens adnate to base of corolla tube or attached to receptacle, isomerous, diplostemonous or polystemonous; when isomerous alternate with corolla lobes, when diplostemonous then in 2 cycles; anthers usually linear-lanceolate or oblong; longer than filaments; filaments free or connate at base, often connate in pairs alternating with singles; glabrous or variously pubescent; anthers bilocular, dehiscent by longitudinal slits or these sometimes initially resembling apical pores; pollen grains tricolporate. Gynoecium of 2–8–connate biovulate carpels as indicated by the number of styles or stigmas, each carpel with a longitudinal false secondary septum and then each locule appearing 1-ovulate, or without a false septum and 2-ovulate, with apical-axile placentation; ovules pendulous, oblong, anatropous with 4, 6, 8, 10, 12, 14 or 16 per ovary. Ovary commonly pubescent, sometimes glabrous; styles distinct or connate, sometimes obscure; stigmas often bifid. Fruit a leathery or fleshy berry, pubescent, glabrate or glabrous; seeds 1–10(–16), pendulous, usually oblong and laterally compressed, often segment shaped, with thin testa and abundant, hard, often ruminate endosperm; embryo straight or curved, cotyledons foliaceous.

A genus of over 500 species worldwide, in Asia, tropical Africa, South America, tropical and subtropical regions of Australia and Pacific islands. In Australia a genus of one naturalised and 21 native species, 13 endemic.

Key to Australian species of *Diospyros* using male flowers

1 Flowers 4–6-merous; filaments adnate to corolla tube **2**
1. Flowers mostly 3-merous (rarely 4 or 5-merous); filaments not adnate to corolla tube . . **12**

2 Filaments glabrous or with a few short appressed hairs **3**
2. Filaments pubescent or puberulent, hairs generally not appressed **8**

3 Petiole and midvein glabrous; petiole nearly flat above; calyx lobed to less than one quarter of its length; lobes 0.4–1(–1.5) mm long; corolla tube 6–8 mm long **4**
3. Petiole and midvein not glabrous; petiole channelled adaxially; calyx lobed to two thirds of its length; lobes 1–2.5 mm long; corolla tube 1–3 mm long **6**

4 Stamens less than 12; free part of filaments and base of anthers and connectives with short appressed hairs . . . . . **3. D. uvida**
4. Stamens 12 or more; filaments and connectives glabrous or with a few scattered hairs . . . **5**

5 Inflorescence with 1–3 flowers; hairs on pedicel and corolla white to grey **1. D. calycantha**
5. Inflorescence with 3–10 flowers; hairs on pedicel and corolla pale to orange-brown . . . . . **2. D. hebecarpa**

6 Secondary veins 4 or 5 pairs; corolla outside more or less glabrous; pistillode glabrous . . . . . **4. D. rugosula**
6. Secondary veins 9–15 pairs; corolla outside pubescent; pistillode pubescent **7**

7 Twig hairs pale brown; secondary veins abaxially prominently raised; corolla tube 2–3 mm long; corolla lobed from one half to two thirds its length; pistillode 1–1.5 mm long . . . . . **22. D. mabacea**
7. Twig hairs white or grey; secondary veins abaxially flush or indistinct; corolla tube 1–1.5 mm long; corolla lobed to at least two thirds its length; pistillode 2.5–3.5 mm long . . . . . **20. D. australis**

8 Filaments with long dense hairs, 0.5–1 times length of anthers **9**
8. Filament hairs *c.* 0.1 mm long, much shorter than anthers **10**

9 Lamina discolorous, usually light grey-green below; apex acute, sometimes acuminate or obtuse; filaments 0.5–1.5 mm long; anthers linear to lanceolate, 2–3 mm long . . . . . **21. D. pentamera**
9. Lamina concolorous or slightly discolorous; apex mostly acuminate; filaments 2.5–2.75 mm long; anthers ovate, 1–1.25 mm long . . . . . **19. D. granitica**

10 Lamina hairs on underside mostly erect, curved or sometimes tortuous, more dense along the veins; midvein pubescent adaxially; anthers 4–5 mm long . . . . . **7. *D. kaki**
10. Lamina either glabrous or the hairs when present sparse, appressed and straight, mostly confined to the main veins abaxially, midvein glabrous adaxially; anthers less than 3 mm long **11**

11 Lamina glands (nectaries) on underside scattered along basal half of lamina, less than 0.5 mm across; each inflorescence with mostly 10–30 flowers . . . . . **6. D. fasciculosa**
11. Lamina glands on underside 1(–2) on each side of midvein confined to extreme base of lamina, more than 1.5 mm across; inflorescence with less than 10 flowers . . . . . **5. D. maritima**

12 Rheophytic tree, lamina 0.8–1.7 cm wide; 4–5 times longer than wide; obtuse at apex; restricted to Roaring Meg Ck catchment, NE Qld . . . . **18. D. rheophila**
12. Not rheophytic; lamina length frequently less than 4 times width, apex various **13**

13 Lamina when dry with prominent reticulate venation, nearly as prominent as secondary veins **14**
13. Lamina when dry with relatively obscure reticulate venation compared to the secondary veins **15**

14. Twigs usually with relatively persistent short erect hairs (sometimes not evident in southern populations) and scattered longer appressed submedifixed hairs . . . . . **8. D. compacta**
14 Twigs glabrescent, without erect hairs, only sparse appressed submedifixed hairs. . . . . **9. D. areolifolia**

15 Stamens (2–)3–5 . . . . . **16**
15. Stamens mostly 6–9 . . . . . **18**

16 Midvein raised above . . . . . **16. D. peninsularis**
16. Midvein not raised above **17**

17 Lamina mostly 1–3 cm wide; secondary veins 15–30 pairs; petiole 2–3 mm long, strigose; inflorescence mostly axillary; corolla tube 4–4.5 mm long . . . . . **15. D. yandina**
17. Lamina mostly 3–5.5 cm wide; secondary veins 7–15 pairs; petiole 3–5 mm long; inflorescence cauline, ramal and axillary; corolla tube 1.5–2 mm long . . . . . **17. D. pluviatilis**

18 Corolla tube 8–11 mm long; stamens 7–8.7 mm long; filaments 3.5–4 mm long, anthers 4–4.5 mm long . . . . . **13. D. laurina**
18. Corolla tube to 4 mm long; stamens to 3.5 mm long, filaments to 2 mm long, anthers to 2.5 mm long **19**

19 Youngest twigs with more or less persistent minute erect hairs as well as caducous appressed hairs **20**
19. Youngest twigs glabrous or with caducous appressed hairs, minute erect hairs absent **21**

20 Lamina elliptic, oblanceolate or lanceolate, 3.5–10 cm long, acute or acuminate at apex; margins sometimes undulate, inflorescence bracts suborbicular, 0.25–0.3 mm long; pistillode 1–2.5 mm long . . . . . **14. D. hemicycloides**
20. Lamina obovate, rarely elliptic, rarely more than 3.5 cm long, obtuse or rounded at apex; margins often recurved, inflorescence bracts obovate, 1.5–2 mm long; pistillode 0.5–1 mm long . . . . . **10. D. humilis**

21 Secondary veins 5–8 pairs. Inflorescence frequently with more than 7 flowers; inside of calyx with appressed hairs . . . . . **11. D. geminata**
21. Secondary veins 10–15 pairs. Inflorescence with up to 7 flowers; inside of calyx glabrous . . . . . **12. D. littorea**

Key to Australian *Diospyros* species using fruit and female flowers

1 Staminodes present. Flowers 4 or 5 (or 6)-merous. Ovary (3-)4 or 8-locular with 1 or 2 ovules per locule, a total of (6) or 8 ovules; fruiting calyx 4–6-lobed. **2**
1. Staminodes absent. Flowers 3-merous (rarely 4 or 5-merous); ovary (2–)3(–6)-locular, with (1) or 2 ovules per locule, a total of 4 or 6 ovules; fruiting calyx 3-lobed (rarely 4 or 5-lobed) **12**

2 Lamina glabrous on underside before full expansion **3**
2. Lamina puberulous to pubescent on underside, glabrescent at full expansion. **6**

3 Flowers 3–10 on each axis, the calyx lobes 2–2.5 mm long; corolla lobes 2.5–3 mm long; corolla tube 2–2.5 mm long; fruiting calyx tube glabrous inside; margin of calyx tube not elevated above base of lobes, fruit several in each axil or sometimes solitary . . . . . **6. D. fasciculosa**
3. Flowers solitary; calyx lobes 4.5–11 mm long; corolla lobes 9–10.5 mm long; corolla tube 4–6.5 mm long; fruiting calyx tube pubescent inside; margin of calyx tube more or less elevated above base of lobes, fruit solitary **4**

4 Corolla lobes less than 5 mm long; ovary and style glabrous or with few hairs; fruit 15–18 mm diameter, glabrous . . . . . **1. D. calycantha**
4. Corolla lobes more than 5 mm long. Ovary and style densely pilose or pubescent; fruit more than 20 mm diameter, pubescent **6**

5 Corolla lobes 5.5–6.5 mm long, fruit 30–40 mm diameter, pubescent with erect pale reddish brown hairs . . . . . **2. D. hebecarpa**
5. Corolla lobes 9–10.5 mm long, fruit 22–25 mm diameter, appressed pubescent with white or pale brown hairs . . . . . **3. D. uvida**

6 Fruiting calyx lobes and tube cupular; the calyx appressed to base of fruit throughout; fruit 9–15 mm wide **7**
6. Fruiting calyx tube cupular and appressed to base of fruit, the lobes spreading or reflexed, or whole calyx flat or reflexed; fruit 15–35(–90) mm wide **9**

7 Lamina hairs, on abaxial surface minute, less than 0.25 mm long; pistillode *c.* 2 mm long; staminodes glabrous; ovary 2.5–3 mm long . . . . . **20. D. australis**
7. Lamina hairs, on abaxial surface more than 0.25 mm long; pistillode 0.75–1.5 mm long; staminodes with long dense hairs at apex; ovary 1.5–2 mm long **8**

8 Lamina concolorous, dull green or drying brown, apex acuminate; calyx lobes on fruit indistinct or broadly deltate; 0–2 mm long . . . . . **19. D. granitica**
8. Lamina discolorous, light green beneath, apex acute or obtuse; calyx lobes on fruit distinctly deltate, 2–4 mm long . . . . . **21. D. pentamera**

9 Fruiting calyx lobes 2–6 mm long **10**
9. Fruiting calyx lobes 6–20 mm long. **11**

10 Twig sericeous; lamina tip acuminate or acute; lamina glands sparse; secondary veins indistinct or slightly depressed above; calyx lobes on fruit oblong . . . . . **22. D. mabacea**
10. Twig glabrous or strigose; lamina tip obtuse or rounded; lamina glands 1–3 near base; secondary veins raised above; calyx lobes on fruit deltate or indistinct . . . . . **5. D. maritima**

11 Petiole 2–6 mm long; flower 5–6 mm long; style 0.4–0.6 mm long; calyx tube on fruit up to 3 mm long, fruit 17–25 mm long . . . . . **4. D. rugosula**
11. Petiole 10–25 mm long; flower 15–25 mm long; style 3–4 mm long; calyx tube on fruit 7–10 mm long, fruit 30–40 mm long. . . . . **7. *D. kaki**

12 Corolla tube 7–8 mm long, lobes 4–5 mm long; fruiting calyx becoming indurated (thickened and woody), densely appressed sericeous or pubescent outside . . . . . **13. D. laurina**
12. Corolla tube up to 4.5 mm long, lobes up to 3 mm long; fruiting calyx thin, not indurated, sparsely appressed puberulous, glabrescent outside **13**

13 Flowers usually in pairs or threes, only a few may be solitary **14**
13. Flowers mostly solitary in each axil **16**

14 Fruiting calyx lobed for more than half its length, more or less flat, not cupular . . . . . **17. D. pluviatilis**
14. Fruiting calyx lobes much shorter than the cupular tube **15**

15 Ovary glabrous, fruiting calyx lobes spreading or reflexed . . . . . **6. D. fasciculosa**
15. Ovary sericeous, fruiting calyx lobes appressed to the fruit, not spreading or reflexed . . . . . **11. D. geminata**

16 Rheophytic tree, lamina 0.8–1.7 cm wide; 4–5 times longer than wide; obtuse at apex; restricted to Roaring Meg Creek catchment, NE Qld . . **18. D. rheophila**
16. Not rheophytic, lamina length frequently less than 4 times width; more widespread distribution **17**

17 Lamina when dry with prominent reticulate venation on both surfaces, nearly as prominent as secondar veins 18
17. Lamina when dry with relatively obscure reticulate venation compared to the secondary veins **19**

18 Twigs usually with relatively persistent short erect hairs (sometimes not evident in southern populations) and scattered longer appressed submedifixed hairs . . . . . **8. D. compacta**
18. Twigs glabrescent, without erect hairs, only appressed submedifixed hairs that soon fall . . . . . **9. D. areolifolia**

19 Midvein raised on adaxial surface of lamina . . . . . **16. D. peninsularis**
19. Midvein not raised on adaxial surface of lamina **20**

20 Ovary glabrescent or glabrous except for a few hairs around style **21**
20. Ovary sericeous **22**

21 Young stems and petioles with sparse appressed submedifixed hairs, erect hairs absent; peduncle of fruit 2–3 mm long . . . . . **12. D. littorea**
21. Young stems and petiole with dense short erect hairs and scattered appressed hairs; peduncle of fruit 0.5–1 mm long . . . . . **10. D. humilis**

22 Twig indumentum glabrescent; secondary veins 5–12 pairs; flowers 3–5 mm long; corolla tube 2.5–3 mm long peduncle 3–7.5 mm long **14. D. hemicycloides**
22. Twig indumentum persistent; secondary veins 15–30 pairs; flowers 5–6 mm long; corolla tube 3–7 mm long, peduncle *c.* 1 mm long . . . . . **15. D. yandina**

1. Diospyros calycantha O.Schwarz, *Repert. Spec. Nov. Regni Veg.* 24: 93 (1927). **Type citation:** [Northern Territory.] "Port Darwin, Jervais road, dry jungle, *F.A.K. Bleeser 156, 160, 161, 638*" (syn: B†). **Type:** Northern Territory. 3.2 km S of U.D.P. Falls, 2 October 1986, *M.J. Clark 698* (neo [here designated]: BRI); isoneo: DNA, *n.v.*).

Tree to 15 m, sometimes andromonoecious. Twigs with basifixed appressed hairs, that soon fall, and minute, more persistent dense or sparse erect hairs. Leaves: petiole 2–6 mm

long; lamina elliptic, 4.5–15 cm long, (1–)2.5–6.5 cm wide; base cuneate; glands mostly 3–7 scattered on each side of midvein on basal half of lamina, rarely absent; margins flat; apex obtuse or acute, glabrous above and below; secondary veins mostly 9–14 pairs, not prominent, tertiary veins inconspicuous. **Male** inflorescence shortly branched, to 2 mm long, mostly with 3–6 flowers; pedicels to 1.5 mm long, grey pubescent; calyx cupular, 2.5–2.7 mm long, shortly 4-lobed, lightly appressed pubescent inside. Corolla tube 6–8 mm long, lobes 4(–5), ovate or oblong, recurved, 3–4 mm long, with a few scattered grey hairs outside, glabrous inside. Stamens 14–16, unequal, 1.5–5.5 mm long, glabrous, filaments connate at base mostly in pairs and adnate to base of corolla tube; anthers linear, 1.2–1.6 mm long, connective produced; pistillode subglobose, hirsute at apex. **Female** flowers mostly solitary, peduncle 3–4 mm long; bracts and bracteoles persistent; calyx tube 3.5–4 mm long, lobes 4, rhomboid, depressed ovate or semiorbicular, mucronulate or not, spreading, 5–8 mm long, 7–8 mm wide, glabrous. Corolla tube 6–6.5 mm long, tubular but narrowed towards base, lobes 4, ovate, recurved, 3.5–4.5 mm long, apex acute. Staminodes mostly 6 or 7. Ovary ovoid, with some appressed hairs at base, nearly glabrous towards style, 8-locular with 1 ovule per locule, style *c.* 3 mm long, stigmas shortly bilobed. Fruiting calyx tube cupular, appressed to base of fruit, lobes spreading or recurved, oblong, 6–8 mm long, glabrous; tube 3–4 mm long with an elevated rim, inside pubescent. Fruit depressed globose, or globose, 15–18 mm diameter, glabrous, orange to red, 5–7-seeded; seeds 10–14 mm long, 3–8 mm wide. **Fig. 1A–F.**

***Additional selected specimens examined*: Western Australia.** 6 km S of Mining Camp in Crusher Vine Thicket, Mitchell Plateau, N Kimberley, Jan 1989, *Kenneally KFK10845 & Hyland* (DNA, PERTH). **Northern Territory**. Maxwell Creek, Melville Island, Jan 1990, *Russell-Smith 8169 & Lucas* (BRI); Hanguana jungle, Melville Island, Jan 1988, *Russell-Smith 4601* (DNA); Cobourg Peninsula, Wurgurlu Bay, Oct 1987, *Russell-Smith 3661 & Lucas* (BRI); Ginger Palmer's camp, Gunn Point, Oct 1990, *Russell-Smith 8345 & Brock* (BRI, MEL); Daly River, Mar 1989, *Brock 725 & Russell-Smith* (BRI); East Alligator River, Aug 1973, *Must 1147* (BRI, CANB, NSW); Lightning Dreaming, Arnhem Land, Feb 1984, *Dunlop 6594 & Wightman* (BRI, CANB, NSW); Nourlangie Ranger Station, May 1980, *Craven 5668* (BRI, CANB, L, MEL); Head of Koolpin Creek, West Arnhem Land, May 1978, *Webb & Tracey 12926* (BRI, CANB). **Queensland.** Cook District: Batavia Downs, 3.1 km east of the western boundary fence on the Mission River track, Oct 1989, *Neldner 2812 & Clarkson* (BRI); Magnificent Creek, 10.8 km E of Rutland Plains, May 1992, *Clarkson 9444 & Neldner* (BRI); Shelfa Crossing, Mitchell River, Alice Mitchell Rivers NP, 27 km NE of Kowanyama, Aug 1994, *Myles HUM1078 et al.* (BRI); Mungkan Kandju NP, 2.5 km SW of Jabaroo Outstation, Coen River, Nov 2008, *Forster PIF34605 & McDonald* (BRI); 13 km N of junction of Archer and Coen Rivers, Jun 1993, *Neldner 4073* (BRI); Archer Bend NP, 120 km WNW of Coen, Jun 1994, *Fell DGF4373 & Buck* (BRI); Archer River, Wenlock – Coen Road, Jul 1930, *Brass 19727* (BRI); Archer River, just upstream from the Peninsula Development Road, Apr 1991, *Clarkson 8965 & Neldner* (BRI).

***Distribution and habitat*:** *Diospyros calycantha* occurs in north Queensland (Cape York Peninsula and the Torres Strait Islands), in the Northern Territory, mostly north of Katherine, and in the Kimberley, northern Western Australia (**Map 1**). It is found mostly in semi-deciduous notophyll vine forest and gallery forest. The species has also been recorded from Papua New Guinea.

***Phenology*:** Flowers have been recorded from January to September, and fruit from March to October.

***Notes*:** The syntypes for *Diospyros calycantha* in the Berlin herbarium were destroyed during World War 2. A neotype has therefore been selected.

2. Diospyros hebecarpa A.Cunn. ex Benth., *Fl. Austral.* 4: 286 (1868). **Type:** Queensland. [Cook District:] Cape York, *s.dat.*, *W. Hill 127* (syn: K); Endeavour River, June 1819, *A. Cunningham 308* (syn: K; isosyn: BM); East Coast [Australia], in 1820, *A. Cunningham s.n.* (syn: BM).

***Illustration*:** Cooper & Cooper (2004: 155).

Tree to 20 m. Twigs with a few sparse appressed hairs, glabrescent, soon glabrous. Leaves: petiole 2–7 mm long, glabrous; lamina broadly ovate, oblong, or elliptic, 5–13 cm long, 2.5–5.5 cm wide; base shortly attenuate; glands few or several, then not confined to basal half of lamina; margins flat; apex obtuse or scarcely

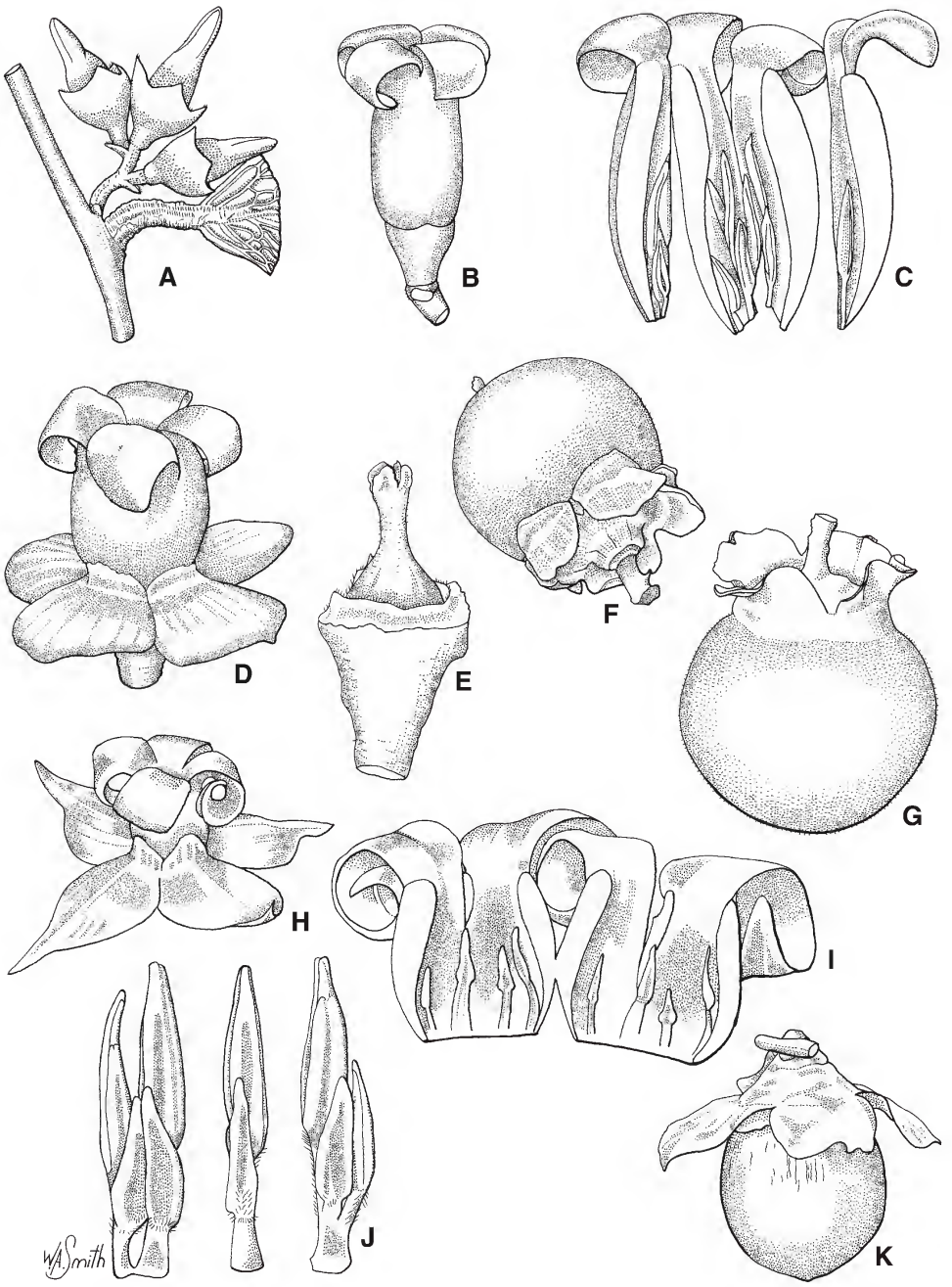

Fig. 1. A–F: ***Diospyros calycantha***. A. male flower buds ×3. B. male flower ×3. C. dissected male petals showing stamens ×4. D. female flower ×3. E. dissected female flower showing ovary ×4. F. fruit ×2. **G:** ***D. hebecarpa***. G. fruit ×1. **H–K:** ***D. uvida***. H. female flower ×2. I. dissected female corolla ×4. J. stamens from male flower ×8. K. fruit ×1. A from *Russell-Smith 8169 & Lucas* (BRI); B & C from *Neldner 4073* (BRI); D & E from *Russell-Smith 4601* (DNA); F from *Clarkson 9444 & Neldner* (BRI); G from *Hyland 11211*(BRI); H & I from *Jessup GJM379 et al.* (BRI); J from *Jago 7032* (BRI); K from *Cooper WWC1895* (BRI).

acuminate; slightly discolorous and glabrescent to glabrous below; secondary veins 6–10 pairs, slightly raised above and below, basal pair of secondary veins sometimes longer and more acute than more distal veins, reticulate veins above and below slightly raised. **Male** inflorescence axes 3–11 mm long, with 3–10 flowers; pedicel hairs golden-brown. Calyx tube 3–3.5 mm long shallowly 4-lobed, lobes up to 0.5 mm long, acute, inside puberulous. Corolla tube 6–7 mm long, lobes 4, ovate to oblong; 2.5–3.5 mm long; outside appressed puberulous in middle of lobe with pale golden-brown hairs. Stamens 12–18, 3.5–6.5 mm long, glabrous or with a few hairs on the connective; filaments single or connate in pairs or threes and adnate to base of corolla tube, 1.5–4 mm long, glabrous; anthers linear, 2–3 mm long; pistillode 1–1.5 mm long, pubescent. **Female** flowers solitary, peduncle 4–6 mm long. Calyx tube 3.5–5 mm long; outside sparsely puberulous, inside sericeous, 4(–5)-lobed; lobes ovate, depressed ovate or elliptic-oblong, 7.5–8.5 mm long; 3–6 mm wide, spreading, glabrescent, apex acuminate, acute or obtuse. Corolla tube 5–6 mm long, glabrous inside, lobes 4, 5.5–6.5 mm long, apex acute, outside puberulous in middle of lobes. Staminodes 7 or 8. Ovary 3–4 mm long, densely pilose with erect hairs, 8-locular, ovules 1 per locule; style 2–3 mm long, pilose. Fruiting calyx tube cupular and appressed to base of fruit, 8–9 mm long, inside pubescent, lobes oblong, depressed ovate or broadly obovate, rounded or apiculate, reflexed, 7–10 mm long, 9–13 mm wide, margins recurved, glabrescent or glabrous. Fruit solitary, globose or depressed globose, 30–45 mm diameter, yellow, orange or red, pubescent with pale erect hairs; seeds 13–15 mm long. **Fig. 1G.**

***Additional selected specimens examined*: Queensland.** Cook District: Dauan Island, Mt Cornwallis, Oct 1981, *Clarkson 3916* (BRI); Somerset, Cape York Peninsula, May 1962, *Webb & Tracey 6110* (BRI); 15 km from the main Bamaga to Jardine River Road on the track east to Ussher Point, Sep 1985, *Clarkson 6230* (BRI); Restoration Island, Aug 1965, *Gittins 1060* (BRI); NPR 8, Parish of Weymouth, Oct 1981, *Hyland 11211* (BRI), Jan 1982, *Hyland 11561* (BRI); Rocky River on eastern foothills of McIlwraith Range, Oct 1969, *Webb & Tracey 9469* (BRI); Hope Vale Mission Reserve, Aug 1978, *Kanis 1940* (BRI, L); Portion 5, Parish of Cook, 15° 32'S, 145° 13'E, Dec 1988, *Hyland 25647RFK* (BRI); SFR 310, Goldsborough LA, Jul 1980, *Hyland 10541* (BRI), Oct 1998, *Hyland 16088* (BRI); SFR 933, Trinity, Little Pine LA, Dec 1989, *Hyland 25724RFK* (BRI). North Kennedy District: Just S of Dittmer township, upper Kelsey Creek, WSW of Proserpine, Aug 1993, *McDonald 5568 & Bean* (BRI); Airlie Beach, Sep 1992, *Batianoff 9209302* (BRI); Conway NP, Mt Rooper walking track, Nov 1985, *Warrian CW943* (BRI). South Kennedy District: R.60 Ossa, Cape Hillsborough, May 1975, *Hyland 4273RFK* (BRI); Hidden Valley Road, Cape Hillsborough, 10 km SE of Seaforth, Apr 1988, *Thompson 138* (BRI); Skull Knob, St Helens Beach, 10 km NE of Calen, Jul 1994, *Batianoff 94073 & Dillewaard* (BRI); NW section of Mt Beatrice, Eungella NP, *s. dat.*, *Pearson SP474* (BRI); Dolphin Heads, Mackay, Sep 1994, *Batianoff 94092 & Saltman* (BRI).

***Distribution and habitat*:** *Diospyros hebecarpa* occurs in northern Queensland, from Torres Strait to Rollingstone, NW of Townsville, and from N of Proserpine to Mackay (**Map 2**). It also occurs in Papua New Guinea and many parts of Malesia. It is found in several types of vineforest.

***Phenology*:** Flowers have been recorded from December to April, and fruit from June to December.

3. Diospyros uvida Jessup **sp. nov.**; resembling *D. hebecarpa*, but differing in having male flowers with 9 stamens and these with short appressed hairs on the free part of the filaments (12–18 stamens and glabrous filaments in *D. hebecarpa*); and female flowers with corolla lobes 9–10.5 mm long (5.5–6.5 mm long in *D. hebecarpa*), and fruit developing to 22–25 mm diameter and appressed pubescent (30–45 mm diameter and pubescent with erect hairs in *D. hebecarpa*) and with fruiting calyx lobes spreading and 12–14 mm long (reflexed and 7–10 mm long in *D. hebecarpa*). **Typus:** Queensland. Cook District: Opposite Burton's dairy farm, end of Towalla Road, SE of Malanda, 29 October 2003, *A. Ford AF4188 & J. Holmes* (holo: BRI).

Diospyros sp. Swipers LA (B.Hyland 1984RFK); Queensland Herbarium database; Hyland *et al.* (2003).

Diospyros sp. (Swipers Flat); Cooper & Cooper (2004: 156).

Tree to 10 m, often flowering as a shrub. Twigs soon glabrous. Leaves: petiole 5–8 mm long, glabrous, lamina elliptic or oblanceolate, 6–12

mm long, 2.5–6.5 cm wide; base cuneate; glands few or if several, then not confined to basal half of lamina; margins flat; apex shortly and bluntly acuminate, glabrous both sides before full expansion; secondary veins mostly 5–9 pairs, slightly raised above and below, basal pair of secondary veins sometimes longer and more acute than more distal veins, reticulate veins above and below slightly raised. **Male** inflorescence axes 3–10 mm long, branched or not, few or multiple axes crowded in a leaf axil, with up to 6 flowers maturing together; pedicels with scattered pale brown hairs; calyx cupular to obconical, glabrescent, tube 2.5 mm long, inside sparsely puberulous, lobes 4, obtuse, 0.5–0.7 mm long. Corolla tube 7–7.5 mm long, lobes 4, oblong, 4.3–4.7 mm long, acute or obtuse, a few appressed hairs present in middle of lobe on outside, otherwise glabrous. Stamens 9 (2+2+3+2), 3.5–5 mm long, free part of filaments and base of anthers and connectives with short appressed hairs, basal part of filaments connate for about 1 mm, glabrous; anthers narrowly oblong or narrowly triangular, acute, connective not visible at the apex; pistillode *c.* 0.8 mm long, pubescent. **Female** flowers solitary, peduncle 2–4 mm long. Calyx tube 3.5–4 mm long, appressed puberulous outside and inside, 4-lobed, lobes broadly ovate or obovate, acuminate, 9–11 mm long, 6.5–8 mm wide, glabrescent or glabrous both surfaces. Corolla tube 4–5 mm long, glabrous inside, appressed puberulous towards lobes outside, lobes 4, narrowly ovate, 9–10.5 mm long, recurved at anthesis, apex acute, outside puberulous in middle of lobes. Staminodes 7 or 8. Ovary 3–4 mm long, densely appressed pubescent with white or pale brown hairs, 8-locular, ovules 1 per locule, style 2–2.5 mm long, pubescent. Fruiting calyx tube cupular and appressed to base of fruit, 5–8 mm long, inside pubescent, lobes broadly ovate, acuminate, spreading, 12–14 mm long, 10–15 mm wide, glabrescent or glabrous. Fruit solitary, subglobose, apiculate at style remnant, 22–25 mm diameter, sparsely appressed pubescent with white or pale brown hairs, glabrescent, reddish black; seeds 13–14 mm long. **Fig. 1H–K.**

***Additional selected specimens examined*: Queensland**. Cook District: Eastern slope of Mt Sorrow, Feb 1993, *Weiblen 207* (BRI); Clacherty Road, *c.* 4.5 km NNE of Julatten, Oct 2007, *Jago 7032* (BRI); Foothills, Thornton Peak, Sep 1937, *Brass & White 301* (BRI); Baileys Creek, N of Daintree River, in 1962, *Webb & Tracey 6496* (BRI); Daintree River, Dec 1929, *Kajewski 1449* (BRI); Mossman River Gorge, Feb 1932, *Brass 2131* (BRI); Intake, Mossman, Sep 1948, *Smith 3970* (BRI); Rex Range, *c.* 2.8 km from Mossman – Julatten Road, *c.* 9 km NE of Julatten, Dec 1988, *Jessup 876 et al.* (BRI); Rex Range, Mar 1991, *Sankowsky 1252 & Sankowsky* (BRI); Formerly TR55, *c.* 300 m along snig track, near Whyanbeel, Sep 2000, *Ford AF2436* (BRI); Creek behind Karnak, tributary of Whyanbeel Creek, Daintree NP, Nov 1996, *Jago 4160* (BRI); SFR 310, Swipers LA, Oct 1968, *Hyland 1984RFK* (BRI) & *Hyland 1997* (BRI); Boonjee LA near Bartle Frere track, 0.8 km S Bobbin Bobbin Falls, 5.4 km NE Boonjee, Nov 1988, *Jessup GJM379 et al.* (BRI); SFR 194, *c.* 600 m NE of tower, Longlands Gap, off McKell Road, Jul 2001, *Ford AF2906* (BRI); Towalla Road, Topaz, Aug 2004, *Cooper WWC1895* (BRI).

***Distribution and habitat*:** *Diospyros uvida* occurs in north east Queensland from Mt Sorrow near Cape Tribulation to near Julatten and also in Wooroonooran NP and adjacent areas on the Atherton Tableland (**Map 3**) mostly in mesophyll vine forest.

***Phenology*:** Flowers have been recorded from October to December, and fruit from January to August.

***Etymology*:** The species epithet is from Latin *uvidus* meaning wet and humid and refers to the Wet Tropics rainforest habitat where the species grows.

4. Diospyros rugosula R.Br., *Prodr.* 526 (1810). **Type:** [Northern Territory] Carpentaria, Groote Eylandt, 15 January 1803, *R. Brown iter Austral. 2827* (holo: BM; iso: K).

Diospyros rugulosa R.Br. (*orthogr. error*) in A.DC., *Prodr.* 8: 229 (1844).

Diospyros bundeyana Kosterm., *Blumea* 23: 454 (1977). **Type:** Northern Territory. W. Arnhem land, Mt Bundey, 21 July 1971, *M.M. van Balgooy & N. Byrnes 1284* (holo: L).

Diospyros cordifolia auct. non Roxb.; Bentham (1868: 286).

Diospyros montana auct. non Roxb.; Bakhuizen van den Brink (1936: 265–270).

Deciduous shrub or tree to 7 m. Twigs pubescent with pale brown hairs, glabrescent. Leaves: petiole 2–6.5 mm long; channelled above, pubescent; lamina chartaceous, elliptic, obovate, or ovate, 2–9(–14) cm long, 2–4(–5.5) cm wide; base cuneate; glands sparse; margins flat or undulate; apex obtuse, acute or acuminate; pubescent with erect curved hairs, glabrescent; secondary veins 4–5 pairs. **Male** inflorescence axes up to 1 cm long; bracteate, mostly 2 or 3 flowered; peduncle, pedicel and outside of calyx pubescent with erect hairs; calyx tube 1–1.5 mm long, lobes 4, ovate, *c.* 2 mm long, inside glabrous. Corolla contorted; lobes 4; oblong to ovate; 5–6 mm long; tube 2–2.5 mm long, outside glabrous except a few hairs on margin. Stamens (14–)16, subequal, 4–5 mm long; filaments adnate to corolla tube in pairs one above the other or shortly connate, 0.3–0.8 mm long, glabrous; anthers narrowly oblong-lanceolate, acute, 2.5–3.2 mm long, with scattered short hairs; pistillode subglobular, less than 1 mm, glabrous. **Female** flowers solitary, peduncle 3.5–5 mm long, bearing 2 foliaceous bracts. Calyx 4-lobed; 5.5–7 mm long, tube 2–2.5 mm long, lobes broadly ovate or suborbicular, 3.5–5 mm long; outside and inside pubescent. Corolla urceolate, contorted, tube 2.5–3 mm long, lobes 4, ovate, obtuse, 4.2–4.8 mm long, ciliate on apical margin, otherwise glabrous. Staminodes 4. Ovary pyramidal and shallowly lobed, 3–3.5 mm long; glabrous; 8-locular; with 1 ovule per locule; styles 4, connate only at base, *c.* 1.5 mm long, bifurcating at the stigmatic apex and with scattered erect hairs. Fruiting calyx tube up to 3 mm long, lobes reflexed, oblong or narrowly ovate, 6–9 mm long. Fruit globose or subglobose; 17–25 mm long, 25–30 mm wide, glabrous, 2–8-seeded; seeds segment-shaped, rugulose, up to 15 mm long. **Fig. 2A–G.**

***Additional selected specimens examined*: Western Australia.** Karrakatta Bay, E of Cape Leveque, Dampier Peninsula, SW Kimberley Coast, Jun 1982, *Kenneally 8534* (PERTH); Port Warrender, N. Kimberley, Jun 1974, *Beard 7032* (PERTH); Walsh Point on W side of Port Warrender off Admiralty Gulf, Jun 1985, *Fryxell et al. 4756* (CANB). **Northern Territory.** Port Darwin, in 1883, *Holtz* 378 (MEL); Port Darwin, in 1884, *Holtz* 435 (MEL); Inverell Bay, 6 km W of Nhulunbuy, Nov 1989, *Forster PIF5955* (BRI, MEL); Flinders Peninsula, Dec 1987, *Dunlop 7446* (BRI); Gunn Point, Nov 1989, *Forster PIF5923 & Russell-Smith* (BRI); Mission Hole, Elizabeth Downs Station, May 1984, *Rankin 2906* (BRI); 10 km S Cannon Hill, Nov 1983, *Russell-Smith 840* (BRI); Mataranka Falls, Roper River, Oct 1988, *Russell-Smith 6195 & Lucas* (BRI); Wagait Road, 10 km N of Finnis River Crossing, Oct 1984, *Wightman 1679* (BRI); East Alligator River, 1 mile [1.6 km] E of crossing, Jul 1972, *Byrnes 2721* (CANB, K); Victoria River, Dec 1855, *Mueller s.n.* (MEL); 10 km SW of Timber Creek township, Victoria River Region, May 1990, *Menkhorst 1023* (MEL); 40 km NE from Numbulwar, Nov 1987, *Russell-Smith 4239 & Lucas* (BRI); 16 Mile Caves Reserve, Katherine, Oct 1977, *Parker 1152* (CANB); Towercast Area, 16 Mile Caves Reserve south of Katherine, May 1978, *Webb & Tracey 12300* (BRI); 8 km WSW of Borroloola, May 1987, *Latz 10440* (BRI); Carpentaria Hwy 15 km from Daly Waters, Apr 1993, *Egan 2061* (BRI); Fitzgerald Range 11 km N of Victoria River Downs Station, Mar 1989, *Russell-Smith 7640 & Lucas* (BRI).

***Distribution and habitat*:** *Diospyros rugosula* occurs from Cape Leveque to the Anjo Peninsula, northern Western Australia and is scattered throughout the Northern Territory, north of around 16°20'S latitude (**Map 3**). It is found in monsoon forest, semi-deciduous microphyll or notophyll vine thicket, fringing mangroves or in the vicinity of waterways. It probably also occurs in Timor and Indonesia.

***Phenology*:** Flowers have been recorded from October to December, and fruit from October to June.

***Notes*:** This species was combined with *Diospyros cordifolia* Roxb. by Bentham (1868) and also with *D. montana* Roxb. by Bakhuizen van den Brink (1936) but was described as a distinct species by Kostermans (1977) who compared it with *D. cordifolia* and was apparently unaware of Brown's name for the same taxon (Brown 1810). In *D. montana* and *D. cordifolia* the stamen filaments are connate forming a common filament 1–2 mm long whereas in *D. rugosula* there is practically no common filament, the stamens attach to the corolla tube one above the other. The pistillode is globular and slightly lobed and lacks the apical style remnants found in *D. montana* and *D. cordifolia*. It shares the same number of staminodes (4) in the female flower as *D. montana* whereas in *D. cordifolia* there are 8–12 staminodes. The calyx is smaller and

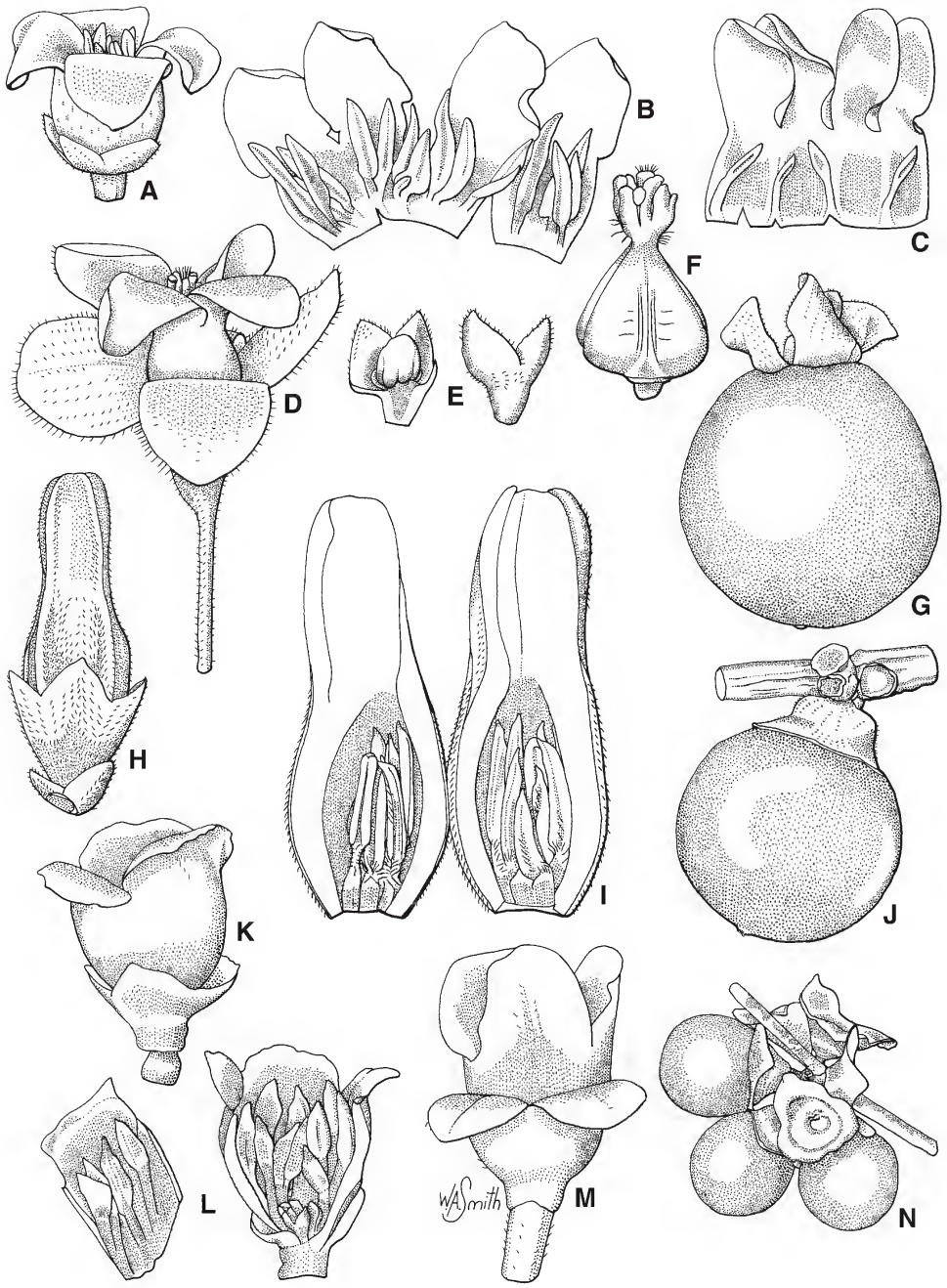

Fig. 2. A–G: *Diospyros rugosula*. A. male flower ×4. B. dissected male corolla showing stamens ×4. C. dissected female corolla showing staminodes ×4. D. female flower ×4. E. dissected male hypanthium showing pistillode ×4. F. dissected ovary ×6. G. fruit ×1.5. **H–J: *D. maritima*.** H. male flower bud ×4; I. dissected male corolla showing stamens ×6; J. fruit ×1.5. **K–N: *D. fasciculosa*.** K. male flower ×8. L. dissected male flower showing stamens and pistillode ×8. M. female flower ×6. N. infructescence ×1. A, B, E from *Russell-Smith 840* (BRI); C, D, F from *Forster PIF5923 & Russell-Smith* (BRI); G from *Webb & Tracey 12300* (BRI); H & I from *Martin 90* (BRI); J from *Weber 10006* (BRI); K & L from *Fell DGF3396 et al.* (BRI); M from *Brass 19969* (BRI); N from *Fell DGF3995 et al.* (BRI).

less deeply lobed than in these two species and the styles have scattered erect hairs (glabrous in *D. montana* and *D. cordifolia*).

5. Diospyros maritima Blume, *Bijdr. Fl. Ned. Ind.* 669 (1826). **Type citation:** "ad littora australie Javae insulae". **Type:** possible type at P, online image!

Cargillia laxa R.Br., *Prodr.* 526 (1810); *Diospyros laxa* (R.Br.) F.M.Bailey, *Syn. Queensl. Fl.* 299 (1883), *nom. illegit. non* Teijsm. & Binnend. (1855). **Type:** Northern Territory. Gulf of Carpentaria opposite Groote Eylandt, 10 February 1803, *R. Brown iter Austral. 2829* (holo: BM; iso: K).

Cargillia megalocarpa F.Muell., *Fragm.* 5: 163 (1866). **Type:** Northern Territory. Escape Cliffs, Arnhem Land, in Nov/Dec 1865, *John McKinlay & Charles Hulls s.n.* (syn: MEL 232960 & 232961).

Diospyros nitens W.Fitzg., *The Western Mail 21* (1066) 10 (2 Jun. 1906), *nom. inval., J. Proc. Roy. Soc. Western Australia* 3: 192 (1918). **Type:** [Western Australia.] Devils Pass, Napier Ranges, May 1905, *W.V. Fitzgerald 614* (syn: PERTH 01598880); Synnott Range near Sprigg River, August 1905, *W.V. Fitzgerald 1321* (syn: PERTH 02890143 & 02890151; isosyn: NSW926658, online image!).

Tree to 25 m. Twigs with appressed hairs, glabrescent. Leaves: petiole 5–14 mm long; lamina coriaceous, oblong to ovate, elliptic or lanceolate, 5.5–30 cm long, 2–12 cm wide; base cuneate or rounded; 1 or sometimes 2 glands on each side of midvein at base of lamina; margins often recurved; apex obtuse or rounded; glabrescent to nearly glabrous; midvein depressed above, secondary veins 7–15 pairs. **Male** inflorescence axes up to 2 mm long with 3–8 flowers; calyx mostly 4-lobed, appressed pubescent, tube 2.5–3 mm long, lobes 1–1.5 mm long, glands sometimes present. Corolla appressed pubescent or sericeous outside, glabrous inside, tube 5.5–6.5 mm long, lobes 4, 4.5–6 mm long. Stamens 16–18(–20), 3–5 mm long, in two whorls, filaments 1–1.5 mm long, connate in pairs and adnate to the tube, pubescent near anther; anthers linear, 1.8–2.6 mm long, connectives usually with some appressed hairs. **Female** flowers solitary, peduncle *c.* 2 mm long, calyx tube 3–5 mm long; lobes 4, 2–2.5 mm long, acute, appressed pubescent outside, densely sericeous inside. Corolla tube 5–7 mm long, lobes 4, ovate–oblong, acute or acuminate, 6–9 mm long, 3–5 mm wide, staminodes 4–10, 3.5 mm long. Ovary ovoid, ferruginous pubescent, 3–4 mm diameter, 8-locular, locules uniovulate, style 2–4 mm long, puberulous, stigmas lobed. Fruiting calyx patelliform, appressed to base of fruit. Fruit depressed globose, 15–20 mm long, 20–30 mm wide, glabrescent, black, 1–6-seeded; seeds 8–10 mm long. **Fig. 2H–J.**

***Additional selected specimens examined*: Western Australia.** Chimney Rocks, (Emerian Point), NE of Dampierland, Feb 1986, *Martin 90* (BRI); *loc. cit.*, Mar 1986, *Martin 91* (BRI); Surveyors Creek Road turnoff between Mitchell Plateau mining camp and Point. Warrender Road, May 1981, *Tracey 15115* (BRI); Neville Creek, off Calder River, Eastern Walcott Inlet, May 1983, *Milewski 174* (BRI); Harding Range N of Eastern Walcott Inlet, May 1983, *Fell 40* (BRI); Hidden Island, Buccaneer Archipelago, Jun 1982, *Kenneally 8403* (BRI); Carson Escarpment; gully below Wonjarring Falls, 4 km NNE of Face Point adjacent Drysdale River NP boundary, Jun 1984, *Forbes 2314* (BRI). **Northern Territory.** Cape Hotham, 1.5 km S, Jun 1988, *Russell-Smith 5446 & Lucas* (BRI); West Alligator Head, Jun 1988, *Russell-Smith 5622 & Lucas* (BRI); New Year Island, Jul 1992, *Leach 3132* (BRI); 5 km SSE of De Courcy Head at Arafura Sea, May 1988, *Munir 6052* (BRI); Arnhem Land, *c.*15 km SE from Cape Cockburn, Jun 1988, *Weber 10006* (BRI); Banjo Beach, Melville Island, Jan 1966, *Stocker GS35* (BRI); Warangaya, Elcho Island, Sep 1987, *Russell-Smith 3273 & Lucas* (BRI); Wessel Islands, Sep 1972, *Latz 3259* (BRI); Groote Eylandt, Bartalumba Bay, Jul 1972, *Dunlop 2640* (CANB). **Queensland.** Cook District: Perry Island, Feb 1991, *Card PER11* (BRI); Evans Bay, 26 km NE of Bamaga, Feb 1994, *Fell DGF3906 et al.* (BRI); McIvor River Crossing, Cooktown – Starke Road, *Tracey 14437* (BRI); Stephens Island, slope east of beach; east of Cowley Beach, Sep 2010, *Ford AF5773 & Bradford* (BRI).

***Distribution and habitat*:** *Diospyros maritima* occurs from near Derby, northern Western Australia, to Groote Eylandt, Northern Territory, and from northwest Cape York Peninsula and Torres Strait to near Cowley Beach, northeast Queensland (**Map 4**). It also occurs in Indonesia, Timor and Papua New Guinea. The species is found in coastal and subcoastal vineforest, near mangroves and on coral cays.

***Phenology*:** Flowers have been recorded in January and February, and fruit from March to November.

6. Diospyros fasciculosa (F.Muell.) F.Muell., *Austral. Veg.* 35 (1866); *Maba fasciculosa* F.Muell., *Fragm.* 5: 163 (1866); *Ebenus fasciculosa* (F.Muell.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891). **Type:** [Queensland. Moreton District:] Brisbane River, December 1856, *F. Mueller s.n.* (lecto [here designated]: MEL 92392).

Maba laxiflora Benth., *Fl. Austral.* 4: 290 (1868). **Type:** Queensland. [Port Curtis District:] Rockhampton, *s.dat., P. O'Shanesy 277* (holo: MEL 92396).

Maba ruminata Hiern, *Trans. Cambridge Philos. Soc.* 12: 135 (1873). **Type:** New Caledonia, in 1861, *J.F. Deplanche 311* (holo: P, online image!).

Diospyros sp. (Claudie River D.G.Fell DGF3042); Jessup (1997, 2002, 2007, 2010).

Tree to 20 m. Twigs glabrescent or glabrous. Leaves: petiole 6–10 mm long; ± flat above, glabrous; lamina elliptic, ovate or oblanceolate, 6–19 cm long, 2.5–7 cm wide; base cuneate; glands less than 0.5 mm across, sparsely scattered; margins recurved; tip acute, acuminate or rounded; above and below glabrous; midvein on upper surface flush, raised, or depressed, secondary veins 6–10 pairs, above and below slightly raised, tertiary veins above and below slightly raised, flush or indistinct, above sparsely reticulate, or reticulation obscure. **Male** inflorescence axes usually 3–12 in axillary fascicles, each axis branched with mostly 3–10 flowers, appressed puberulous, glabrescent. Calyx shallowly 3 or 4-lobed, 1.2–1.5 mm long, glabrescent. Corolla campanulate, tube 2–2.5 mm long, glabrous, lobes 3 or 4, semicircular or depressed obovate, 1.5–2 mm long. Stamens 8–16(–20); 1.8–2.5 mm long; filaments connate at base in pairs and adnate to tube at base, 1–1.2 mm long, puberulous with erect or antrorse hairs; anthers narrowly ovate, 1.2–1.5 mm long, connective glabrous or with a few hairs; pistillode 0.5–0.75 mm long, glabrous. **Female** flowers 3–10 in a fascicle, 5–10 mm long; pedicel 1.75–4 mm long. Calyx 3 or 4-lobed; lobes 2–2.5 mm long; tip rounded; tube 1.2–1.5 mm long; outside puberulous; inside glabrous. Corolla lobes 3 or 4, rounded, 2.5–3 mm long with a median line of hairs; tube 2–2.5 mm long. Staminodes 0–4. Ovary 2–3 mm long, glabrous, 6-locular with 1 ovule per locule, tapering to connate styles and 2 or 3 shortly lobed stigmas. Fruiting calyx tube cupular and appressed to base of fruit, 5–7 mm long, lobes spreading or reflexed, 4–6 mm long. Fruit broadly ellipsoid or subglobose; 13–15 mm long, 10–15 mm wide, apex and base rounded, glabrous, 4–6-seeded; seeds 10–11 mm long. **Fig. 2K–N.**

***Additional selected specimens examined*: Queensland.** Cook District: Frangipani Beach Scrub, 0.7 km S of Cape York, 26.4 km NE of Bamaga, Feb 1994, *Fell DGF3995 et al.* (BRI); Stony Point N of Pascoe River, Cape York Peninsula, Nov 1977, *Webb & Tracey 13857* (BRI); Turrel Hill, 10 km WSW of Nesbit River mouth, 51.6 km N of Silver Plains Homestead, Cape York Peninsula, Aug 1993, *Fell DGF3396 et al.* (BRI); Nesbit River, Sep 1973, *Hyland 6831* (BRI); Bonanza Creek, Peach River, Aug 1948, *Brass 19969* (BRI); Mt Stuckey Area NW Starcke Station, Sep 1974, *Tracey 14292* (BRI). North Kennedy District: SE foothills of Mt Dryander, Mar 1969, *Smith s.n.* (BRI [AQ410106]); Adjacent to Impulse Creek, Apr 1999, *McDonald 6683 & Squires* (BRI). Port Curtis District: Olsens Capricorn Caverns, The Caves, Mar 1988, *Vavryn 60* (BRI); Curtis Island, Dec 1984, *Gibson 685* (BRI); Essendean Bridge, crossing of Baffle Creek, between Berajondo and Agnes Water, Jan 2008, *Forster PIF33230 et al.* (BRI); SF 53, Dan Dan Scrub, Dec 1987, *Gibson 985* (BRI). Burnett District: Coongara Rock, 11 km SE of Coalstoun Lakes, SF 1344, Nov 2002, *Forster PIF29110* (BRI). Wide Bay District: Dundowran Beach, Apr 2003, *Sankowsky 1994 & Sankowsky* (BRI); Mt Walsh NP, Palm Valley, Coast Range, Nov 2008, *Forster PIF34508* (BRI); Tinana Creek, 7 km ENE of Tiaro, Jan 2005, *Forster PIF30537 et al.* (BRI). Moreton District: Mt Eerwah, 4 km W of Eumundi, Sep 1984, *Sharpe 3578* (BRI, NSW); S of Summit, Little Mt Brisbane, Nov 1984, *Guymer 1903 & Dillewaard* (BRI); Moggill FR, Nov 2005, *Halford Q8626 et al.* (BRI). **New South Wales.** North Coast: Woody Head, 3 miles [4.8 km] N of Iluka, Nov 1966, *McGillivray 2673 et al.* (BRI, NSW).

***Distribution and habitat*:** *Diospyros fasciculosa* occurs on eastern Cape York Peninsula north of Starcke NP, and from Mt Dryander, central Queensland to Iluka, northeast New South Wales (**Map 4**). It also occurs in New Caledonia, Fiji and Eastern Java. The species is commonly found in riverine,

coastal and other types of lowland notophyll vineforest.

***Phenology*:** Flowers have been recorded from August to December and fruit from November to July.

***Notes*:** Singh (2005) nominated the Mueller collection at MEL as lectotype. However, there is no evidence that he saw any of the syntypes in MEL and as the Mueller collection from the Brisbane River is mounted on two sheets MEL 92392 and MEL 92394, with two separate labels, I have chosen the former as a subsequent lectotypification as allowed under Art. 9.17 of the International Code of Nomenclature (Melbourne Code).

7. *Diospyros kaki Thunberg, *Nova Acta Regiae Soc. Sci. Upsal.* 3: 208 (1780). **Type:** not designated.

Tree to 6 m, deciduous. Twigs pubescent or nearly glabrous. Leaves: petiole 10–25 mm long; lamina broadly elliptic to suborbicular or ovate, 5–12 cm long, 2.5–10 cm wide; base cuneate to rounded or shortly decurrent; glands scattered along length of lamina, sometimes few or absent; margins flat; apex obtuse to shortly acuminate; pubescent below, mostly on main veins, midvein pubescent above; midvein depressed above, secondary veins 5–7 pairs. **Male** inflorescence axes 5–8 mm long; in 3–5-flowered cymes. Calyx tube 1.2–1.5 mm long, lobes 4, 4.5–5 mm long, 3–4 mm wide, pubescent outside and inside; corolla tube urceolate, 6–7 mm long, lobes 4, ovate, recurved, 3–4 mm long, glabrous or with a ciliate margin. Stamens 14–24, filaments connate at base and adnate to base of corolla tube, 1–1.5 mm long; anthers oblong, 4–5 mm long, top of filaments and connectives appressed pubescent; pistillode disc-like, 0.7 mm diameter, glabrous. **Female** flowers solitary, pedicel 10–12 mm long. Calyx 4-lobed, tube 4–5 mm long lobes 10–13 mm long, acute, pubescent both sides, glabrescent; corolla 10–15 mm long, 4-lobed, lobes ovate, recurved, 4.5–5 mm long, Staminodes 8–16. Ovary 3–5 mm long, sericeous or glabrous, 8-locular with 1 ovule per locule, style 4-fid, 3–4 mm long, stigmas 2-fid. Fruiting calyx reflexed, 30–40 mm diameter. Fruit depressed globose to broadly ovoid, 30–40 mm long, 20–85 mm wide, glabrous or nearly so, yellow to orange; seeds 18–25 mm long.

***Selected specimens examined*: Queensland.** Wide Bay District: Glenbar Road, SF 57 St Mary's, *c.* 18 km W of Tiaro, Aug 2003, *Watts s.n.* (BRI [AQ762450]). Moreton District: Yandina Creek, 2.5 km E of Valdora and *c.* 6 km NE of Yandina on Yandina Creek Road, *Sharpe 4530* (BRI); SF E of Clear Mountain Road, Cashmere; tributary of Four Mile Creek, Apr 2011, *Phillips 2153 & Phillips* (BRI); Brisbane Valley Rail Trail: Mt Hallen – Esk Section, Mar 2012, *Phillips 2247 & Phillips* (BRI); Kobble Creek (most northerly branch), Dec 2008, *Phillips 1898 & Phillips* (BRI); Paradise Road, Pallara, *c.* 15 km S of Brisbane GPO, Nov 2003, *Bean 21147* (BRI).

***Distribution and habitat*:** *Diospyros kaki* is native to China and possibly Japan and is widely cultivated for its edible fruit. It is naturalised in southeast Queensland, from near Tiaro to south of Brisbane (**Map 5**). Clumps of trees sometimes persist in abandoned gardens.

***Phenology*:** Flowers have been recorded in October and fruit in March.

8. Diospyros compacta (R.Br.) Kosterm., *Blumea* 23: 454 (1977); *Maba compacta* R.Br., *Prodr.* 528 (1810); *Ebenus compacta* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891); *Diospyros ferrea* var. *compacta* (R.Br.) Fosb., *Brittonia* 40: 61 (1988). **Type:** [Northern Territory.] North Coast Island y2 [Pobassoo Island], 18 February 1803, *R. Brown iter Austral. 2830* (holo: BM; iso: K).

Maba reticulata R.Br., *Prodr.* 528 (1810); *Ebenus reticulata* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891), *non Diospyros reticulata* Willd. (1805); *Diospyros ferrea* var. *reticulata* (R.Br.) Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 58, 64 (1937). **Type:** [Queensland. Cook District:] Prince of Wales Island e [Good's Island], 2 November 1802, *R. Brown iter Austral. 2831* (holo: BM; iso: K).

Maba interstans F.Muell., *Fragm.* 5: 163 (1866). **Type citation:** "Ad sinum Rockingham Bay, *Dallachy*", *fide* Bentham (1868: 291). **Type:** not located.

Diospyros sp. (Mt White P.I.Forster PIF14415); Jessup (1994, 1997, 2002, 2007, 2010).

Diospyros sp. (Mt White); Cooper & Cooper (2004: 156).

***Illustration*:** Cooper & Cooper (2004: 154).

Shrub or tree to 15 m. Twigs usually with erect hairs *c.* 0.1 mm long and appressed submedifixed hairs 0.3–0.4 mm long, glabrescent. Leaves: petiole (1.7–) 3–5(–8) mm long, flat above, with similar indumentum to twigs. Lamina often coriaceous, obovate, oblong, or elliptic, (1.5–) 3–8 (–12) cm long, (0.8–) 2–4 (–8.5) cm wide; base cuneate; glands 1–4 mostly in basal half, or absent from some leaves; margins slightly to strongly recurved; apex rounded, obtuse or emarginate; glabrescent or soon glabrous; midvein depressed above, secondary veins 4–7 pairs, raised above, sometimes difficult to distinguish from higher order veins, reticulate veins raised above on dried material. Male inflorescence axes up to 3 mm long with (1–)3(–5) flowers, puberulous. Male flower pedicel to 0.5 mm long, puberulous with grey or pale brown hairs. Flower 3.5–4 mm long. Calyx tube 1.5–2.5 mm long, lobes 3(–4), 1–2 mm long, sparsely puberulous, glabrescent outside, glabrous or with a few hairs inside, tip rounded, or obtuse. Corolla tube 2.4–4 mm long, lobes 3, contorted, broadly ovate, 1–1.5 mm long, upper part of tube and lobes appressed pubescent outside, the hairs shorter where the lobes overlap in bud, glabrous inside. Stamens (4–) 6–9, solitary or up to 3 singles alternating with up to 3 pairs, the filaments of a pair connate only at base; filaments not adnate to the corolla tube, 1.2–1.5 mm long, glabrous; anthers linear to lanceolate, 1.5–2 mm long; pistillode up to 1.5 mm long, pubescent. Female flowers mostly solitary; peduncle 0.5–2 mm long, calyx 3(–4)-lobed, tube to 1 mm long, lobes obtuse or rounded, 1–1.5 mm long, sparsely puberulous, glabrescent outside, sericeous inside. Corolla tube 2–4 mm long, sericeous outside, glabrous inside, lobes 3 or 4, broadly ovate, rounded, 1.5–2 mm long, sericeous outside, glabrous inside. Staminodes absent. Ovary 2.5–2.8 mm long, sericeous, 3-locular; ovules 2 per locule; style 0.3–0.5 mm long; pubescent, stigmas shortly lobed. Fruiting calyx recurved or spreading, lobes rounded or indistinct. Fruit solitary, globose or depressed globose, 9–14 mm long, 12–14 mm wide, soon becoming glabrous, 1–4-seeded; seeds 5–6.5 mm long. **Fig. 3A–G.**

***Additional selected specimens examined*: Northern Territory.** Woolaning – Channel Point Road, N of Daly River, May 1978, *Webb & Tracey 12732* (BRI); NE coast of Cape Van Diemen, Melville Island, May 1978, *Webb & Tracey 12730* (BRI); Darwin River, Nov 1974, *Parker 560* (BRI); Darwin, Oct 1946, *Blake 17325* (BRI); Point Stewart, Oct 1983, *Russell-Smith 813* (BRI); Black Jungle, Nov 1982, *Wightman 302 & Dunlop* (BRI, CANB, MEL, NSW); Black Jungle, Feb 1986, *Wightman 2552 & Clark* (BRI, CANB); Cobourg Peninsula, Wurgurlu Bay, Oct 1987, *Russell-Smith 3659 & Lucas* (BRI); Gove, Cape Wirawawoi, Feb 1998, *Wightman 4110* (BRI); Mouth of Angurugu River, Groote Eylandt, Mar 1988, *Russell-Smith 5162 & Lucas* (BRI); Koolatong River, at junction with Maidjung River, Oct 1996, *Cowie 7370* (BRI). **Queensland.** Cook District: Boydong Island, Dec 1987, *Clarkson 7437* (BRI); Stoney Point, N of Pascoe River, Cape York Peninsula, Nov 1977, *Webb & Tracey 13859* (BRI); TR 14, Sep 1975, *Hyland 3290RFK* (BRI, NSW); Mt White, Coen, Dec 1993, *Forster PIF14415* (BRI); Youngmans Crossing, Pascoe River, Nov 1977, *Tracey 14170* (BRI); Palfrey Island, near Lizard Island, Oct 1988, *Batianoff 10305* (BRI); Cook's Lookout, Lizard Island, Sep 1988, *Batianoff 10214* (BRI); Green Island, Coral Cay, E of Cairns, Aug 1993, *Jago 3016* (BRI). North Kennedy District: Conway NP, Shute Harbour, about 35 km NE of Proserpine, Nov 1985, *Sharpe 4135* (BRI); Track to Swamp Bay, Conway Range NP, about 25 km NE of Proserpine, Nov 1985, *Sharpe 4108* (BRI). South Kennedy District: Turtle Bay, Carlisle Island, 35 km N [of] Mackay, Sep 1986, *Sharpe 4391 & Batianoff* (BRI); Mt Bassett, Mackay, Mar 1993, *Batianoff 9303439 et al.* (BRI). Port Curtis District: Near homestead, Middle Percy Island, Nov 1989, *Batianoff 11798 et al.* (BRI).

***Distribution and habitat*:** *Diospyros compacta* occurs in the Northern Territory from the Daly River to Groote Eylandt and in Queensland from Torres Strait and Cape York Peninsula to Middle Percy Island, central coastal Queensland (**Map 5**). It is found in semi-deciduous vine thicket and riparian forest, frequently on coastal sands and near mangroves.

***Phenology*:** Flowers have been recorded from August to November and fruit from November to March.

***Notes*:** Specimens with very narrow oblong leaves with strongly recurved margins are found in the deciduous vine thickets of Cape York Peninsula and in coastal areas exposed to wind shearing. These were placed in BRI under *Diospyros* sp. (Mt White P.I.Forster PIF14415). This variation probably contributed

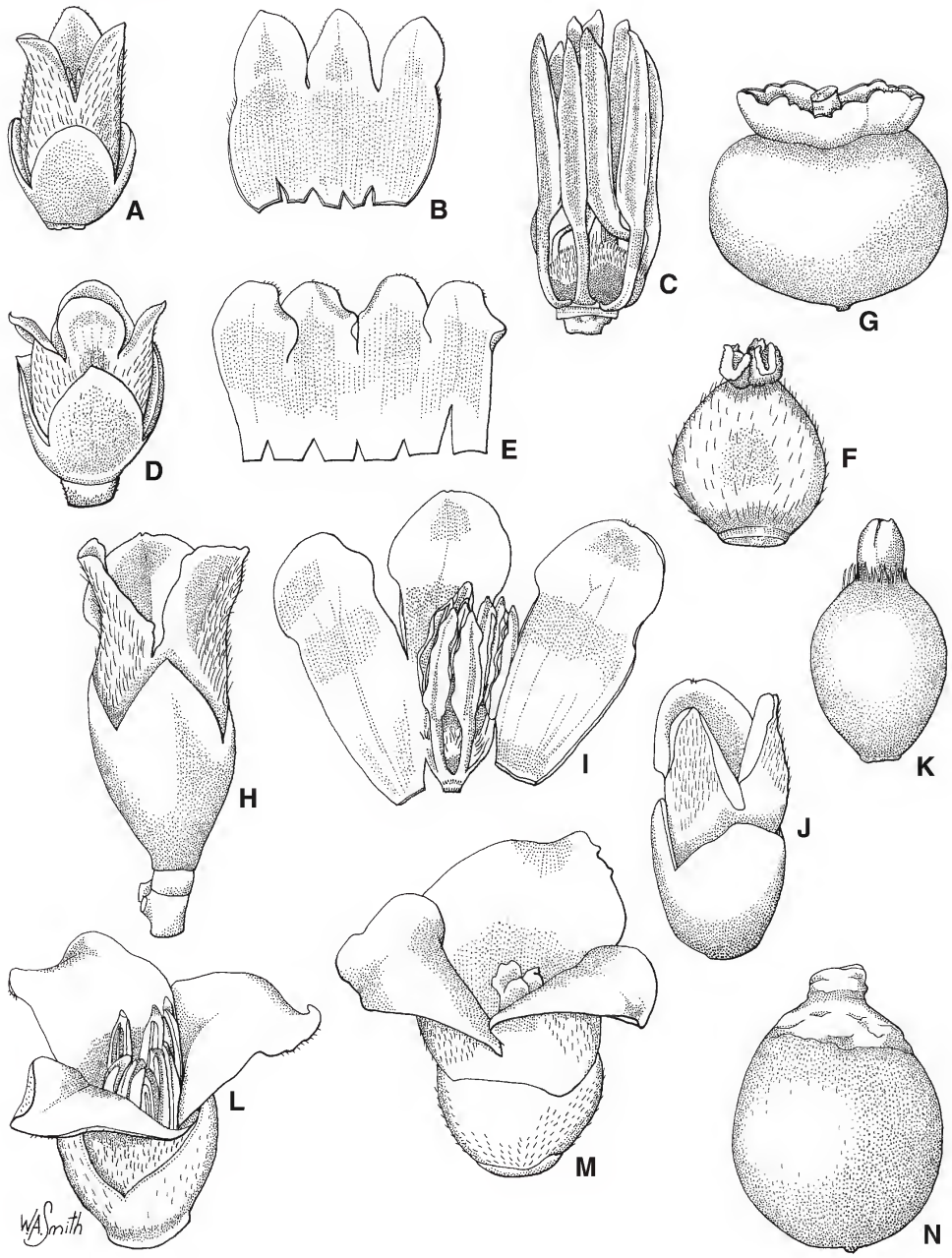

Fig. 3. A–G: *Diospyros compacta*. A. male flower ×4. B. dissected corolla, male flower ×4. C. dissected stamens and pistillode, male flower ×8. D. female flower ×4. E. dissected corolla, female flower ×4. F. dissected ovary, female flower ×8. G. fruit ×3. **H–K: *D. humilis***. H. male flower ×8. I. dissected male flower, showing corolla and stamens ×8. J. female flower ×8. K. dissected ovary, female flower ×12. **L–N: *D. geminata***. L. male flower ×8. M. female flower ×8. N. fruit ×3. A–C from *Jago 3016* (BRI); D–F from *Sharpe 4135* (BRI); G from *Wightman 4110* (BRI); H, I from *Hyland 13692* (BRI); J, K from *White 12487* (BRI); L from *Jessup 919B* (BRI); M from *Jessup 919A* (BRI); N from *Specht & Salt W531* (BRI).

to Brown (1810) describing *Maba compacta* based on specimens from Pobassoo Island, NT ("North Coast Island Y2") and *Maba reticulata* based on specimens from Goods Island, Qld ("Prince of Wales Islands e"). Two taxa were also recognised by Bentham (1868) and by Bailey (1900) but extensive collecting since then has served only to blur any previously perceived boundaries between them. Differences in the calyx noted by the above two authors can be attributed to the degree of maturity of the fruit. Despite searches by myself and others the type of *Maba interstans* F.Muell. has not been found.

9. Diospyros areolifolia Kosterm., *Blumea* 23: 452 (1977). **Type:** Papua New Guinea. Western District: Fly River area, Tarara, Wassi Kussa River, 7 January 1936, *L.J. Brass 8738* (holo: L *n.v.*; iso: A, online image!, BRI).

Small or large tree, once recorded with 90 cm gbh. Twigs with sparse appressed hairs, soon glabrous. Leaves: petiole 3–4 mm long and flat above, with scattered short erect hairs above and appressed hairs below, glabrescent; lamina obovate or oblong-elliptic, (2.5–)4–6(–8) cm long 1.5–3 cm wide; base cuneate or shortly attenuate; glands 1 or 2 on each side of midvein on basal half of lamina below; margins flat; apex obtuse; glabrous above and below or with a few scattered appressed hairs around the midvein below; midvein depressed above, secondary veins 4–8 pairs, hardly distinguishable from the prominent reticulate venation on both surfaces. Male inflorescence axes 2.5–3.5 mm long, pubescent, with mostly erect pale brown hairs *c.* 0.1 mm long, glabrescent. Male flowers not seen. Female flowers not seen. Fruit peduncle 1 mm long; fruiting calyx shallowly cupular, appressed to base of fruit throughout, 2–3 mm long, 5–7 mm diameter, glabrescent outside, appressed pubescent inside, lobes 3, very short and rounded or depressed triangular. Fruit globose, *c.* 7 mm diameter (immature), appressed pubescent towards style, glabrescent, persistent style *c.* 1.2 mm long.

***Additional specimen examined*: Queensland.** Cook District: Wasp Creek area near Lockerbie, Cape York Peninsula, Nov 1962, *Hyland 2517* (BRI).

***Distribution and habitat*:** The species occurs in Queensland on northern Cape York Peninsula (**Map 5**) and in Papua New Guinea.

***Note*:** This species appears to be closely related to *Diospyros compacta*. The type bears only immature fruit and the Queensland specimen appears to be male but has only peduncles lacking flowers. Additional collections are needed to confirm its status as a distinct species.

10. Diospyros humilis (R.Br.) F.Muell., *Austral. Veg.* 35 (1867); *Maba humilis* R.Br., *Prodr.* 527 (1810); *Ebenus humilis* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891); *Diospyros ferrea* var. *humilis* (R.Br.) Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 57–62 (1937). **Type:** [Queensland. Port Curtis District:] Upper Head, Broadsound, [12 & 13 September 1802], *R. Brown iter Austral. 2834* (holo: BM).

Maba obovata R.Br., *Prodr.*, 527 (1810); *Ebenus obovata* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891); *Maba ovata*, *orth. var.* F.Muell., *Hooker's J. Bot. Kew Gard. Misc.* 8: 326 (1856). **Type:** [Northern Territory.] Carpentaria Island a, b, c, 17–28 November 1802, *R. Brown iter Austral. 2835* (holo: BM).

***Illustration*:** Cooper & Cooper (2004: 155).

Shrub or tree to 10 m. Twigs with caducous appressed hairs and persistent short erect hairs. Leaves: petiole 0.9–5 mm long, puberulous with erect hairs; lamina obovate, rarely elliptic, 0.8–3(–5.4) cm long, 0.5–3 cm wide; base cuneate; glands up to 10 on each side of midvein, mostly in basal half; margins flat; apex rounded or obtuse; glabrescent or glabrous above, with scattered appressed hairs below, midvein above puberulous with erect hairs; midvein above depressed, secondary veins 4–10 pairs, reticulate veins not raised above. **Male** inflorescence axes 1–4 mm long; with (2–)3(–4) flowers. Male flower pedicel 0–0.5 mm long, pubescent. Calyx tube 1.5–2 mm long, lobes 3, 0.7–1.5 mm long, triangular, acute or obtuse, glabrous or with few hairs on lobes inside, appressed pubescent outside. Corolla tube 2–3 mm long; lobes 3, ovate to triangular, 1.5–2 mm long, upper part of tube and middle of lobes densely

appressed sericeous outside, glabrous inside. Stamens mostly 9, 3 singles and 3 pairs with filaments connate at base, 2.5–3 mm long, filaments not adnate to tube, 0.75–1.5 mm long, glabrous; anthers linear, 1.4–2 mm long; pistillode *c.* 0.5 mm long, pubescent. **Female** flowers solitary, peduncle to 0.5 mm long. Calyx tube 1.7–2.4 mm long, 3-lobed, lobes triangular, obtuse, 1–1.5 mm long, indumentum as in males. Corolla tube 1.75–3 mm long, lobes 3, broadly ovate, obtuse to rounded, 1.5–2 mm long, indumentum as in males. Staminodes absent. Ovary *c.* 1.8 mm long, glabrescent except for some persisting hairs around the style, 3-locular, ovules 2 per locule, style up to 0.5 mm long, pubescent, stigmas bifid. Fruiting calyx cupular, appressed to base of fruit throughout, 4–5 mm long with rounded or obtuse lobes. Fruit ellipsoid to nearly globular, 10–15 mm long, 7–9 mm wide, yellow or orange, glabrous or nearly so, 1–3-seeded; seeds 7–9 mm long. **Fig. 3H–K.**

***Additional selected specimens examined*: Western Australia.** Cape Leveque, Apr 1988, *Dunlop 7826* (BRI); N of remote weather station, 29 km N of mining camp, Mitchell Plateau, N. Kimberley, *s. dat., Kenneally 8554* (BRI). **Northern Territory.** Arnhem Land; mouth of King River, Oct 1992, *Cowie 3110* (BRI); Cutta Cutta Caves, Oct 1988, *Russell-Smith 6169 & Lucas* (BRI); Bremer Island, Jul 1992, *Leach 2993* (BRI). **Queensland.** Cook District: 4 km N of Edward River Community, Dec 1979, *Clarke 1091* (BRI); Brooklyn, on track to Pennyweight Yards to junction with McLeod River, Nov 2008, *Jensen 1695 &. Stanton* (BRI); Brooklyn Nature Refuge, near Mt Carbine, Nov 2006, *McDonald KRM5936 et al.* (BRI). Burke District: Between Tully and Massacre Inlets, Carpentaria region, Aug 1988, *Hyland 13575* (BRI); Bowthorn Station, 34.6 km NNW of Bowthorn homestead beside Hedleys Creek, Jul 2006, *Thompson WES752 & Hogan* (BRI); Woodu (Muwera) between Nyuldorg and Thabugan Point, Mornington Island, Sep 1981, *Fosberg 62083* (BRI); Karumba, Aug 1943, *Blake 15129* (BRI) & *15129A* (BRI); 18 miles [28.8 km] NW of Normanton township, Aug 1953, *Perry 3959* (BRI, CANB). North Kennedy District: 40 Mile Scrub, Nov 1988, *Hyland 13692* (BRI) & *13693* (BRI). South Kennedy District: 3 km (direct) NW of haul road overpass, near Newlands coal mine, WNW of Glenden, Jun 2009, *Bean 29019* (BRI). Leichhardt District: Dry Creek Valley, eastern side of Ka Ka Mundi section, Carnarvon NP, Aug 1990, *McDonald 4621 & Bean* (BRI); Nathan Gorge, 23 km SW of Cracow, Cabbagetree Creek, Apr 1991, *Telford 11055 & Rudd* (BRI). Port Curtis District: Marmor, Nov 1943, *White 12487* (BRI). Burnett District: Goodnight Scrub NP, Aug 2009, *Jessup 5260 & Bell* (BRI). Wide Bay District: Emu Creek Road, between Dallarnil & Degilbo, Sep 1999, *Forster PIF24915* (BRI). Maranoa District: Western end of Eumina land, 2 km E of junction with the Orallo Road and adjacent to Stanhope Downs, 44 km by road NW of Roma along the Orallo Road, Oct 1996, *Thomas s.n.* (BRI [AQ651179]). Darling Downs District. 14 km S of Bunya Mountains on road to Dalby, Aug 1972, *Sharpe 137* (BRI); McEwan SF, Stoneleigh, off Young road, *c.* 5 km N of Pittsworth, Jul 2011, *Menkins ILM0536* (BRI).

***Distribution and habitat*:** *Diospyros humilis* occurs across northern Australia, from the Dampier Peninsula, northern Western Australia, Northern Territory, and from Torres Strait to Pittsworth southwest of Toowoomba, southeast Queensland (**Map 6**). The species is also found in Timor and Papua New Guinea. It occurs in rainforest, open woodland or deciduous, semi-deciduous microphyll or notophyll vine thicket, on sandy soils, sandstone, limestone karst, or soil derived from basalt.

***Phenology*:** Flowers have been recorded from October to January and fruit from February to December.

***Note*:** Bentham (1868) placed *Maba obovata* in synonymy under *M. humilis* referring to the fact that Brown's specimens of the former had male flowers while specimens of the latter bore fruit. Numerous subsequent collections have revealed some minor differences in leaf size and fruit shape across the range of specimens from eastern Queensland to Western Australia but I am inclined to continue to recognise just the one taxon.

11. Diospyros geminata (R.Br.) F.Muell., *Austral. Veg.* 35 (1867); *Maba geminata* R.Br., *Prodr.* 527 (1810); *Ebenus geminata* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891); *Diospyros ferrea* var. *geminata* (R.Br.) Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 58, 64 (1937). **Type:** [Queensland. Port Curtis District:] Keppel Bay Broad Sound, Thirsty Sound, Broad Sound, [August – September 1802], *R. Brown iter Austral. 2833* (syn: BM, K).

Shrub or tree rarely more than 12 m high. Twigs with very few appressed hairs, glabrescent. Leaves: petiole 2.5–5 mm long, glabrescent; lamina obovate, or elliptic, 3–7.5 cm long, 1–5 cm wide; base attenuate; glands

mostly 1–5 on each side of midvein in basal half; margins sometimes recurved; apex obtuse or rounded; glabrescent or glabrous; midvein slightly depressed above, secondary veins 5–8 pairs, reticulate veins scarcely raised above. **Male** flowers fasciculate on several condensed axes, with mostly 7–20 flowers in each axil. Flower sessile, calyx tube 1.4–2 mm long, lobes 3(–4), 0.6–1 mm long, appressed puberulous, glabrescent outside, appressed pubescent inside. Corolla tube 2.5–3.7 mm long, lobes mostly 3, oblong or ovate, 2–2.5 mm long, inside glabrous, outside appressed pubescent. Stamens 6–9, 2.5–3.5 mm long, filaments not adnate to tube, glabrous, 1.5–2 mm long; anthers linear, 1.5–2 mm long; pistillode 0.5–1 mm long. **Female** flowers fasciculate, sessile, 2–4 on a very short common peduncle. Calyx 3-lobed, tube 1.3–1.8 mm long; lobes 0.8–1.1 mm long, obtuse or rounded, appressed puberulous, sparsely outside, densely inside. Corolla tube 2.5–3.5 mm long, lobes 3, 2–2.5 mm long, obtuse, outside appressed pubescent. Staminodes absent. Ovary 1.5–2 mm long, sericeous, 3-locular; ovules 2 per locule; style 0.4–0.6 mm long, pubescent. Fruiting calyx cupular, lobes appressed to base of fruit throughout. Fruit usually 1 or 2(–4) on a common peduncle, broadly ellipsoid or subglobose, 10–11 mm long, 6–7(–10) mm wide, glabrescent with some appressed hairs remaining around and below the style remnant, 1–3-seeded; seeds 6–7 mm long. **Fig. 3L–N.**

***Additional selected specimens examined*: Queensland.** Cook District: Pennefather River, Nov 2002, *Kemp TH6155 & Kutt* (BRI); Lake Patricia, Weipa, Dec 1993, *Forster PIF14404* (BRI); 8.5 km NW of Weipa Mission, Jul 1974, *Specht & Salt W531* (BRI). North Kennedy District: Castle Hill, Townsville, Feb 1992, *Bean 4064* (BRI); Tuckers Range, Jul 1993, *Fensham 953* (BRI); Woodwark Bay, Apr 1991, *Forster PIF8243 & Bean* (BRI); Mingela Bluff, Jan 1992, *Forster PIF9439 & Bean* (BRI); Mount Louisa West, 30 km SW of Home Hill, Aug 1991, *Bean 3523* (BRI). South Kennedy District: N end of Ten Mile Beach, 5 km S of Midge Point, Repulse Bay, Jun 1994, *Batianoff 9406106* (BRI); Keswick Island, Victor Bay Gully, Sep 1996, *Batianoff 960965 et al.* (BRI); Homestead Bay, St Bees Island, Apr 1989, *Batianoff 11263* (BRI). Leichhardt District: Lake Elphinstone, *s. dat.*, *Dietrich 1654* (BRI, MEL). Port Curtis District: Yeppoon, Keppel Bay, Sep 1931, *White 8126* (BRI); Dan Dan Scrub SF, Boyne Range, Jan 2009, *Forster PIF33359 et al.* (BRI). Burnett District: Goodnight Scrub, *c.* 65 km SW of Bundaberg, Jun 1957, *Smith 9836* (BRI, L). Wide Bay District: Stony Creek, 4 km E of Didcot, Oct 1990, *Forster PIF7514* (BRI); *loc. cit.*, Nov 1993, *Telford 11970* (BRI); NW base of Mt Boogooramunya, SF 648, Jan 1989, *Forster PIF4903* (BRI); Near Imbil, Jun 1947, *Smith & Webb 3132* (BRI, L). Darling Downs District: Northern foothills of Bunya Mountains, 51 km from Kingaroy on Dalby Road, Nov 1984, *Rodd 4223* (BRI). Moreton District: Indooroopilly, near Brisbane River, 1.5 km upstream from Walter Taylor Bridge, Jan 1993, *Jessup 919A & 919B* (BRI); Palen Creek SF near Mt Lindesay, Nov 1993, *Grimshaw G97* (BRI).

***Distribution and habitat*:** *Diospyros geminata* occurs in eastern Queensland from Cape York Peninsula to near Mt Lindesay (**Map 7**), and is also in Papua New Guinea. It is found in microphyll and notophyll vine forest or vine thicket.

***Phenology*:** Flowers have been recorded from December to August and fruit from February to December.

12. Diospyros littorea (R.Br.) Kosterm., *Blumea* 23: 461 (1977); *Maba littorea* R.Br., *Prodr.* 527 (1810); *Maba buxifolia* var. *littorea* (R.Br.) Hiern, *Nova Guinea (Botanique)* 8 (1909); *Diospyros ferrea* var. *littorea* (R.Br.) Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 434 (1941). **Type:** [Northern Territory.] N Coast Bay No 3, Point y2, 3 March 1803, *R. Brown iter Austral. 2832* (holo: BM).

Maba buxifolia auct. non (Rottb.) Pers.; Hiern, *Trans. Cambridge Philos. Soc.* 12: 116–117 (1873).

Diospyros ferrea var. *littorea* f. *laurina* (R.Br.) Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 434, 441 (1941) excluding type. Misapplied name.

Tree to 10 m. Twigs with appressed medifixed hairs, glabrescent. Leaves: petiole 2–6 mm long, glabrescent; lamina narrowly obovate, oblanceolate or elliptic, 2.5–11.5 cm long, 1.5–5 cm wide; base cuneate; glands usually 1–3 on each side of midvein near base; margins often undulate or recurved; apex rounded or retuse; glabrous above, with scattered appressed hairs below, glabrescent; midvein above depressed, secondary veins 10–15 pairs. **Male** inflorescence axes branched, up to 5 mm long, pubescent, with 3–7 flowers in each axil, pedicel to 1.5 mm long. Calyx

tube 0.75–1.25 mm long, lobes 3, 2–2.5 mm long, obtuse or acute, calyx outside sparsely appressed pubescent, inside glabrous. Corolla tube 3.5–4 mm long, lobes 3, narrowly ovate or oblong; 2–3 mm long, upper part of tube and middle of lobes densely appressed sericeous outside, glabrous inside. Stamens 6–9, 3–3.5 mm long; filaments not adnate to tube; glabrous; 1–1.2 mm long; anthers linear, 2–2.5 mm long; pistillode *c.* 0.5 mm long, pubescent. **Female** flowers solitary on a peduncle *c.* 2 mm long. Calyx tube 2.5–3 mm long, 3-lobed, lobes broadly triangular, acute or obtuse, 1.3–1.8 mm long, indumentum as in males. Corolla tube 2.5–3.5 mm long, lobes 3, broadly ovate, obtuse to rounded, 2.5–3 mm long, indumentum as in males. Staminodes absent. Ovary 1.7–2 mm long, glabrous, 3-locular, ovules 2 per locule, style 0.5–1 mm long, sparsely pubescent at base. Fruiting calyx cupular, appressed to base of fruit throughout, 4–4.5 mm long with depressed triangular or rounded lobes. Fruit ellipsoid or oblong, sometimes subglobose, 11–16.8 mm long, 7–14 mm wide, apex rounded or flat, glabrous, yellow or red, up to 6-seeded; seeds to 10 mm long. **Fig. 4A–E.**

***Additional selected specimens examined*: Western Australia.** Camp on unnamed tributary of Prince Regent River, arising 19 km SE of the mouth, Jun 1984, *Kenneally 8920* (PERTH). **Northern Territory.** North-east coast of Cape Van Diemen, Melville Island, May 1978, *Webb & Tracey 12741* (BRI, CANB); Maxwell Creek, Melville Island, Jan 1990, *Russell-Smith 8168 & Lucas* (BRI); Adelaide River, Daly River Road, Nov 1982, *Dunlop 6244 & Wightman* (BRI); Adelaide River, Feb 1979, *Rankin 1752* (BRI, L); 30 km NE of Numbulwar, Nov 1987, *Russell-Smith 4231 & Lucas* (BRI); Black Jungle, Oct 1990, *Brock 736* (DNA); NE Arnhem Land, 2 km S of Lake Peter John, Feb 1988, *Russell-Smith 4984 & Lucas* (BRI); Yirrkala, Gove Peninsula, Oct 1983, *Wightman 810* (BRI); Latram Range, Gove Peninsula, Feb 1988, *Russell-Smith 4984 & Lucas* (BRI); Macarthur River mouth, 14 km SE of Pelican Spit, Jan 1989, *Russell-Smith 6785 & Lucas* (BRI, MEL). **Queensland.** Cook District: Saibai Island, Oct 2007, *Fell DGF8655 & Stanton* (BRI); Olive River, Nov 1978, *Stirling 516* (BRI); Quintil Creek, Lockhart River Aboriginal Reserve, Nov 1977, *Tracey 14598* (BRI); Normanby River, Aug 1979, *Duke A1MS674* (BRI); Batavia [Wenlock] River, in 1888, *Milman s.n.* (BRI [AQ183600]); Claudie River, Aug 1979, *Duke A1M655* (BRI); Marrett River, Princess Charlotte Bay, May 1979, *Elsol 666 & Stanley* (BRI).

***Distribution and habitat*:** *Diospyros littorea* occurs in the Prince Regent River area, WA, in the NT from the Daly River to the Macarthur River and in Queensland from Torres Strait to Princess Charlotte Bay (**Map 7**) in coastal and estuarine vine forest and thickets fringing mangroves. It also occurs from Thailand to Papua New Guinea.

***Phenology*:** Flowers have been recorded from June to December, and fruit throughout the year.

***Note*:** Bakhuizen van den Brink (1941: 434, 440) included Australia in the distribution of *D. ferrea* var. *littorea* f. *lamponga* (Miq.) Bakh., without citing any Australian specimens but also apparently suggesting this form may not be distinct from typical *Maba littorea* R.Br. [" ? *an Maba littorea typica* (1810)"].

13. Diospyros laurina (R.Br.) Jessup **comb. nov.**; *Maba laurina* R.Br., *Prodr.*, 527 (1810); *Ebenus laurina* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891). **Type:** [Queensland. South Kennedy District:] Cumberland Islands, 17 October 1802, *R. Brown iter Austral. 2836* (holo: BM; iso: E, K).

non Diospyros laurina Massalongo, *nom. nud.*, see Notes below).

Diospyros cupulosa (F.Muell.) F.Muell., *Austral. Veg.* 35 (1867); *Maba cupulosa* F.Muell., *Fragm.* 5: 164 (1866). **Type:** [Queensland.] Rockingham Bay, *s.dat.*, *J. Dallachy s.n.* (lecto [here designated]: K 000792604, consisting of two mounted branchlets with fruit attached and loose fruit in the fragment packet with *M. cupulosa* written thereon in Mueller's hand).

Diospyros sericocarpa F.Muell., *Austral. Veg.* 35 (1867); *Maba sericocarpa* F.Muell., *Fragm.* 5: 164 (1866). **Type:** [Queensland.] Rockingham Bay, *s.dat.*, *J. Dallachy s.n.* (lecto [here designated]: K 000792603, top left hand mounted specimen and loose fruits in the bottom left fragment packet with *M. sericocarpa* written thereon in Mueller's hand).

Maba rufa auct. non Labill.; Hiern (1873: 114); Bailey (1900: 963, 1913: 306); Bakhuizen van

den Brink (1936: 444–445); *neque D. rufa* King & Gamble, *J. Asiat. Soc. Bengal, Part 2, Nat. Hist.* 74 (1): 228 (1906).

***Illustration*:** Cooper & Cooper (2004: 154).

Tree to 20 m, often flowering as a shrub. Twigs with dense appressed basifixed reddish-brown hairs, glabrescent. Leaves: petiole 3–8 mm long, glabrescent; lamina elliptic or oblanceolate, 6–13 cm long, 2–5 cm wide; base acute or obtusely cuneate; glands mostly 1–3 on each side of midvein in basal half; margins flat; apex acute, shortly acuminate or rounded; at first with dense appressed hairs both sides, soon glabrescent; midvein above depressed, secondary veins 6–10 pairs, often obscure. **Male** inflorescence axes branched, 1.5–5 mm long, appressed pubescent, usually with 3–12 flowers. Calyx tube 4.5–5.5 mm long, lobes 3, 0.5–1 mm long, obtuse, calyx appressed pubescent outside, glabrous inside. Corolla tube 8–11 mm long; lobes 3, broadly ovate, 2–3 mm long, corolla appressed pubescent outside, glabrous inside. Stamens 9; 7–8.7 mm long; filaments not adnate to tube, 3.5–4 mm long, glabrous; anthers linear, 4–4.5 mm long; pistillode 1–1.5 mm long, pubescent. **Female** flowers 1(–3) in each axil, pedicel to 2 mm long; calyx tube 4.5–5 mm long, appressed pubescent inside and outside, 3(–4)-lobed, lobes 2.5–3 mm long, obtuse or rounded. Corolla tube 7–8 mm long, lobes 3, narrowly ovate, acute, 4–5 mm long, indumentum as in males; staminodes absent; ovary 4–4.5 mm long, coarsely sericeous, 3-locular, ovules 2 per locule, style 1–1.5 mm long, pubescent. Fruiting calyx indurated, accrescent, 14–17 mm long, appressed to base of fruit with lobes 3–6 mm long, slightly recurving, inside sericeous, outside reddish-brown pubescent. Fruit ellipsoid to subglobose, 15–18(–20) mm long, 13–15 mm wide, pubescent, up to 6-seeded; seeds 6.5–7.5 mm long. **Fig. 4F–L.**

***Additional selected specimens examined*: Queensland.** Cook District: 5 km east along Captain Billy Landing road, off Heathlands to Bamaga Road, Cape York Peninsula, Jun 2008, *Forster PIF33747 & McDonald* (BRI); NPR 8 Parish of Weymouth, Oct 1981, *Hyland 11204* (BRI); TR 14 (McIlwraith Range – Leo Creek Road), Sep 1975, *Hyland 8442* (BRI); Rocky River, Sep 1971, *Hyland 5474* (BRI, L); Head of Temple Creek, Cape Melville NP, May 1994, *Fell DGF4340A* (BRI); Oliver Creek, Jul 1997, *Hyland 15749* (BRI); Daintree River, Dec 1929, *Kajewski 1448* (BRI); Mossman River Gorge, Feb 1932, *Brass 2136* (BRI); Churchill Creek, Churchill LA, SF 143, Jul 1995, *Forster 17210 & Figg* (BRI); SFR 1073, Saddle Mt, near Kuranda, Nov 1966, *Berry NQNC14812* (BRI); Smithfield, Saddle LA, Jan 1982, *Hyland 11493* (BRI); SF 607 Freshwater Creek, 7 km along road to Copperlode Dam, Oct 2001, *Forster PIF27564 et al.* (BRI); Bridle Creek, *c.* 12 miles [19.2 km] SE of Mareeba, Nov 1973, *Hartley 14149 & Hyland* (BRI); SFR 310, Gadgarra, Goldsborough LA, Mar 1993, *Hyland 25826RFK* (BRI); SFR 933, Trinity, Little Pine LA, Oct 1988, *Hyland 25587RFK* (BRI); Lake Barrine, Atherton Tableland, Jul 1929, *Kajewski 1154* (BRI); Malanda, Aug 1943, *Blake 15175* (BRI); Palmerston NP, west of Crawford Lookout, Jan 1993, *Bean 5414* (BRI). North Kennedy District: Alcock FR, rafting access point no. 9, 5.2 km from Tully River camping area, Feb 2002, *Ford AF3280 & Holmes* (BRI); South Pinnacle, *c.* 30 km SW of Townsville, Oct 1998, *Cumming 17904* (BRI); Gregory Creek at junction of Gregory River, Nov 1987, *Perry 2* (BRI); Gregory Creek, *c.* 2 km NE of Gregory and 15 km N of Proserpine, Nov 1985, *Sharpe & Perry s.n.* (BRI [AQ423717]). South Kennedy District: Scawfell Island NP, 50 km ENE of Mackay, Nov 1986, *Batianoff 6221 & Krieger* (BRI); Cut Creek at base of Eton Range, SF 652–658, Mackay, Oct 1986, *Ritchie 49* (BRI).

***Distribution and habitat*:** *Diospyros laurina* occurs in northern Queensland from northern Cape York Peninsula to south of Mackay (**Map 8**) in mesophyll and notophyll vineforest and wet sclerophyll forest. It also occurs in Papua New Guinea.

***Phenology*:** Flowers have been recorded from September to November, and fruit from July to February.

***Notes*:** Massalongo (1859) included in a list of fossil species the following: "*Diospyros laurina* Massal. Chiavon." This name is a *nomen nudum* leaving the way open for a new combination to be made based on *Maba laurina* R.Br. which predates *M. cupulosa* F.Muell.

Mueller (1866: 164) described *Maba cupulosa* and *M. sericocarpa* sequentially and both from fruiting material collected by J. Dallachy from Rockingham Bay. The only Dallachy specimens with these two names written in Mueller's hand and with fruiting material are the sheets at Kew cited above and these are selected as the lectotypes of these two names. The other branchlets mounted on K 000792603 have male flower buds and cannot be considered part of the gathering described

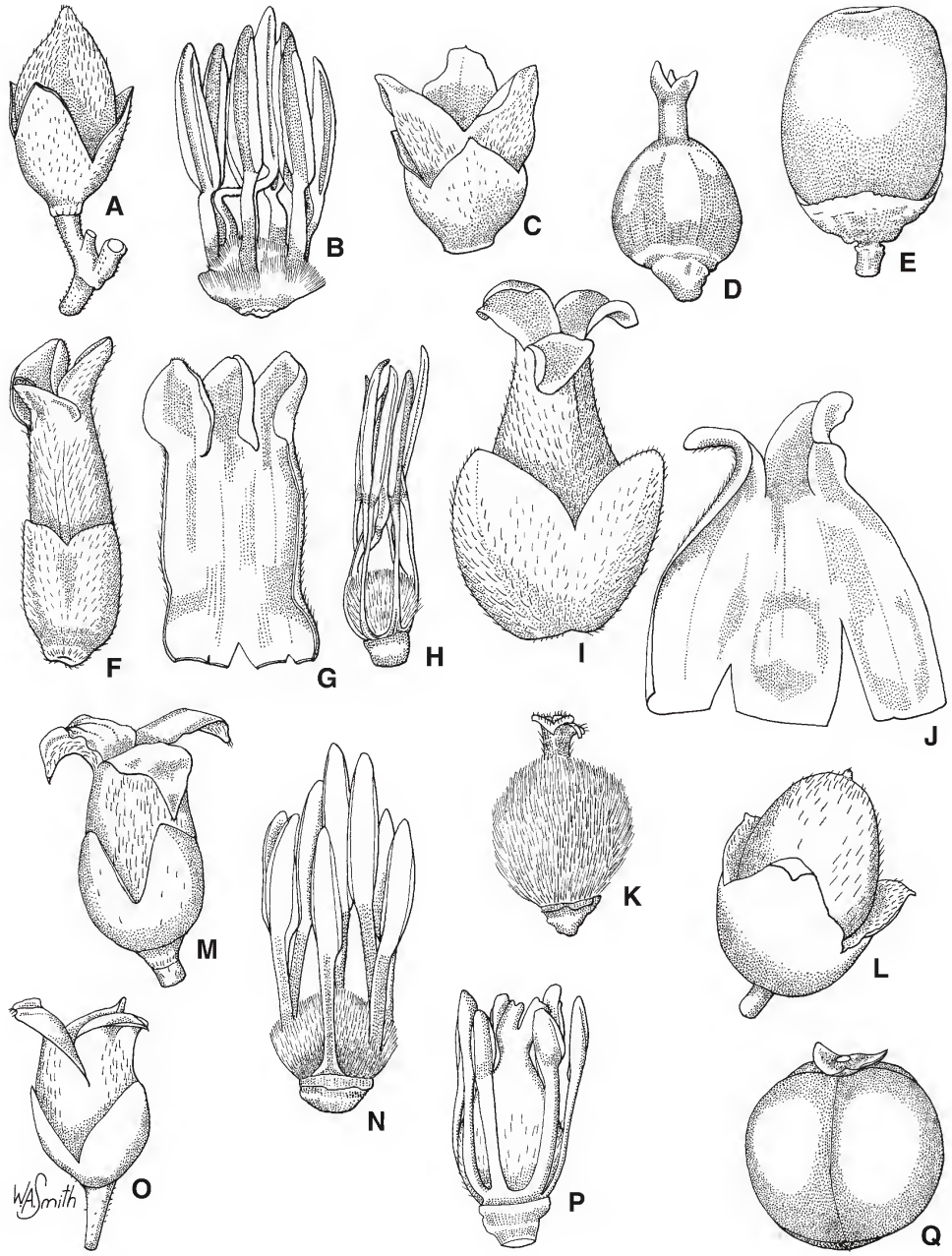

Fig. 4. A–E: ***Diospyros littorea***. A. male flower ×4. B. dissected stamens and pistillode, male flower ×8. C. female flower ×4. D. dissected ovary, female flower ×8. E. fruit ×2. **F–L:** ***D. laurina***. F. male flower ×3. G. dissected corolla, male flower ×3. H. dissected stamens and pistillode, male flower ×4. I. female flower ×4. J. dissected corolla, female flower ×4. K. dissected ovary, female flower ×4. L. fruit ×1.5. **M–Q:** ***D. hemicycloides***. M. male flower ×4. N. dissected stamens and pistillode, male flower ×8. O. female flower ×4. P. dissected ovary and stamens of possible hermaphrodite flower ×8. Q. fruit ×4. A, B from *Dunlop 6244 & Wightman* (BRI); C, D from *Brock 736* (DNA); E from *Duke AIMS674* (BRI); F–H from *Perry 2* (BRI); I–K from *Sharpe & Perry s.n.* (BRI [AQ423717]); L from *Forster PIF27564 et al.* (BRI); M & N from *Hyland 11362* (BRI); O & P from *Hyland 25238RFK* (BRI); Q from *Forster PIF14336* (BRI).

by Mueller. The reference by Bailey (1900: 963) to a specimen of *M. sericocarpa* from Eumundi is incorrect and most likely refers to *D. yandina*.

14. Diospyros hemicycloides (F.Muell. ex Benth.) Jessup **comb. nov.**; *Maba hemicycloides* F.Muell. ex Benth., *Fl. Austral.* 4: 290 (1868); *Ebenus hemicyclodes* (Benth.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891). **Type:** [Queensland.] Rockingham Bay, 13 August 1866, *J. Dallachy s.n.* (syn: MEL 92395; isosyn: K 000792767); Mackay River [Tully River], "Habit of Hemicyclia" in Mueller's hand, 11 August 1866, [*J. Dallachy s.n.*] (syn: MEL 233341A).

Diospyros sp. Q2 (Tinaroo Range J.G. Tracey 13936); Jessup (1994, 1997, 2002).

Diospyros sp. (Mt Lewis L.S. Smith 10107); Jessup (1994, 1997, 2002, 2007, 2010).

Diospyros sp. (Mt Lewis); Cooper & Cooper (2004: 156).

***Illustration*:** Cooper & Cooper (2004: 156), as *D.* sp. (Mt Lewis).

Tree to 18 m, often flowering as a shrub. Twigs with appressed submedifixed pale brown hairs and minute erect hairs, glabrescent. Leaves: petiole 1.5–5 mm long, glabrescent; lamina elliptic, oblanceolate or lanceolate, 3.5–10 cm long, 1–3 cm wide; base cuneate or shortly attenuate; glands small and sparse, up to 5 on each side of midvein below; margins sometimes undulate, apex shortly acuminate or acute; glabrous above, glabrescent below; midvein on upper surface depressed, secondary veins 7–11 pairs. **Male** inflorescence axes 2–9 mm long, with 3(–4) flowers, appressed pubescent, glabrescent. Calyx tube 1.5–2 mm long, lobes 3, 1.5–2 mm long, obtuse or scarcely acute, calyx glabrescent outside, glabrous inside. Corolla tube 2.5–3.5 mm long, lobes 3(–4), ovate or triangular with sides incurved, 3–4 mm long, pubescent outside, glabrous inside. Stamens 7–9, 2–2.5 mm long, filaments not adnate to tube, glabrous, 1.5–1.8 mm long; anthers linear, 1–1.2 mm long; pistillode 1(–2) mm long, pubescent, sometimes with developed styles. **Female** flowers usually solitary, rarely a 3-flowered cyme, peduncle 3–7.5 mm long, glabrescent, pedicel to 1 mm long. Calyx tube 2–2.5 mm long, lobes 3, connate in bud, 2–2.5 mm long, obtuse or acute, glabrescent outside, glabrous inside. Corolla tube 2.5–3 mm long lobes 3, triangular, acute with sides incurved, 2–2.5 mm long, pubescent outside, glabrous inside. Staminodes absent. Ovary 2.2–2.5 mm long, sericeous, 3-locular, ovules 2 per locule, style 0.7–1 mm long, with appressed hairs at base, stigmas bifid. Fruiting calyx appressed to base of fruit, 4 mm long, fruit globose or broadly obovoid-ellipsoid, 13–16 mm long, 11–14 mm wide, with scattered appressed hairs, glabrescent; seeds 8–10 mm long. **Fig. 4M–Q.**

***Additional selected specimens examined*: Queensland.** Cook District: Cedar Bay NP, Mt Finnigan summit area, Horans Creek, Oct 1999, *Forster PIF25062 & Booth* (BRI); Kanawarra, Carbine LA, Nov 1987, *Hyland 25238 RFK* (BRI); Riflemead, Carbine LA, Oct 1988, *Hyland 25556 RFK* (BRI); North Mary LA, [SF]R143 Mt. Lewis, Sep 1973, *Sanderson 335* (BRI); On Mt Lewis Road, 18 km from junction with Mareeba – Mossman Road, Oct 1987, *Foreman 1833* (BRI); SF 143, 15.5 km along Mt Lewis Road, Oct 1999, *Forster PIF25118 & Booth* (BRI); Mt Lewis Road, Aug 1957, *Smith 10107* (BRI); Daintree NP, Mt Sorrow track razorback, 4 km W of Cape Tribulation, Dec 1997, *Forster PIF22004 et al.* (BRI); Davies Creek, Aug 1954, *Smith 5267* (BRI); SFR 185 Danbulla, Tinaroo, Aug 1981, *Tracey 13936* (BRI); SF 185 Danbulla, Tinaroo LA, 7.5 km past western boundary of forestry grid, Dec 1993, *Forster PIF14336* (BRI). Tinaroo Range, Jun 1970, *Moriarty 310* (BRI); Mt Bartle Frere, 1.8 km WSW of Bobbin Bobbin Falls, 4.4 km NNE of Boonjee, Nov 1988, *Jessup GJM1131 et al.* (BRI); SF 194 Mt Baldy, 8 km from Rifle Range end, Jun 1996, *Forster PIF19223 et al.* (BRI); Hugh Nelson Range, Nov 1958, *Smith 10504* (BRI); The Crater NP, Atherton Plateau, Sep 1981, *Fosberg 61674* (BRI). North Kennedy District: Portion 205, Parish of Herberton, Keoghs Scrub, Dec 1991, *Gray 5400* (BRI); Tully Falls NP, 7.6 km along Tully Falls Road from Charmillan Creek bridge, Dec 2007, *Ford AF5196 & Metcalfe* (BRI); SFR 605 Luff LA, Dec 1981, *Hyland 11362* (BRI); 27 km south along Culpa road, SF 605 Koomboloomba, May 2002, *Forster PIF28775 & Booth* (BRI); Yuccabine Creek SF 344, Kirrama LA, 28 km NW of Cardwell, Oct 1988, *Jessup GJM2241 et al.* (BRI), *Jessup GJM2368* (BRI); Northern slope of Mt Thorn, SF 461 Meunga LA, 23.1 km W of Cardwell, Oct 1988, *Jessup GJM 2271 et al.* (BRI); Coast Range [adjacent to Rockingham Bay], Sep 1867, [?*J. Dallachy*] (MEL 244448).

***Distribution and habitat*:** *Diospyros hemicycloides* is endemic to northeast Queensland from Mt Finnigan to the Kirrama Range (**Map 9**) and occurs in simple to

complex notophyll vine forest on soils derived from granite.

***Phenology*:** Flowers and fruit have been recorded from November and December.

***Note*:** Flowers of *Hyland 25238RFK* were observed to sometimes have an enlarged ovary and stamens with slightly smaller anthers. Further collecting is required to determine if some plants of this species are andromonoecious or monoecious.

15. Diospyros yandina Jessup **sp. nov.**; resembling *D. hemicycloides* but differing in the more numerous secondary veins (15–30 pairs compared to 5–12), in the shorter male peduncle (*c.* 1 mm compared to 2–9 mm) and the fewer stamens (3–5 compared to 7–9). It differs from *D. cupulosa* in the fewer stamens (9 in *D. cupulosa*) and in the smaller, thinner, non-accrescent fruiting calyx. **Typus:** Queensland. Wide Bay District: Kin Kin Creek, beside track following boundary of Cooloola National Park, August 1981, *L.W. Jessup 430* (holo: BRI).

Diospyros ellipticifolia f. *australiensis* Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 430, 436 (1941). **Type:** Queensland. Moreton District: Blackall Range, November 1916, *C.T. White s.n.* (holo: BRI [AQ183530]; iso: NSW).

Diospyros major var. *ebenus* f. *australiensis* Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 429 (1941). **Type**: Queensland. Moreton District: Blackall Range, November 1916, *C.T. White s.n.* (holo: BRI [AQ183530]; iso: NSW).

Diospyros sp. (Blackall Range C.T.White AQ183530); Jessup (2013).

Maba sericocarpa auct. non F.Muell.; Baker (1899: 441–442), *neque* Bailey (1900: 963) *pro parte*, "Rockingham Bay, Dallachy".

Diospyros sp.1; Stanley & Ross (1986: 280, 2002 reprint: 280).

Shrub or rarely a tree to 10 m. Twigs with appressed basifixed pale brown hairs and minute erect hairs, glabrescent. Leaves: petiole 2–3 mm long, glabrescent; lamina elliptic, narrowly oblong-ovate or lanceolate, 3–8(–11) cm long, 1–3 cm wide; base cuneate or rounded; glands small and sparse, up to 5 on each side of midvein below; margins often undulate, slightly recurved; apex acute or shortly acuminate; glabrous above, sparsely appressed pubescent, glabrescent below; midvein on upper surface depressed, secondary veins mostly 9–18 pairs, sometimes difficult to distinguish from higher order veins. **Male** inflorescence peduncle *c.* 1 mm long, in the axils of reduced or normal leaves on new season growth, pubescent, with mostly 3 flowers, sessile or pedicels to 0.5 mm, pubescent. Calyx tube 1.5–2.5 mm long, lobes 3, mostly connate at first then 1–2 mm long, mostly acute, calyx appressed pubescent outside, glabrous inside. Corolla tube 4–4.5 mm long, lobes 3, ovate, 2–3 mm long, appressed pubescent or coarsely sericeous outside in the middle of the lobes with shorter indumentum between, glabrous inside. Stamens 3–5, 4–4.5 mm long, filaments not adnate to tube, glabrous, 1.3–1.8 mm long; anthers linear, 1.8–2.2 mm long; pistillode *c.* 1 mm long, pubescent. **Female** flowers solitary, peduncle *c.* 1 mm long, glabrescent, bract and bracteoles 2–2.5 mm long, pedicel 0–0.4 mm long. Calyx and corolla similar to males. Staminodes absent. Ovary 1.7–2 mm long, sericeous, 3-locular, ovules 2 per locule, style 0.25–0.5 mm long, appressed puberulous, stigmas bifid. Fruiting calyx distinctly trilobed, 7–9 mm diameter, only shortly appressed to base of fruit, the lobes spreading or recurved, fruit globose or depressed globose, 9–12 mm long, 11–15 mm wide, with scattered appressed hairs, glabrescent, crimson, 1–5-seeded; seeds 6–7 mm long. **Fig. 5A–C.**

***Additional selected specimens examined*: Queensland:** Wide Bay District. Ramsays Scrub, Cooloola, May 1964, *Webb & Tracey 6348* (BRI); Mt Mothar, near Gympie, Oct 1977, *Webb & Tracey 11253* (BRI); Cooloola NP, road to Harry's Hut, Oct 1982, *McDonald 3772 & Williams* (BRI); Road to Harry's Hut, NE of Kin Kin, Sep 1993, *Bean 6467* (BRI); Lake Cootharaba, *s.dat.*, *Keys 75* (BRI); Kin Kin, s.*dat.*, *Francis s.n.* (BRI [AQ183541]); Mt Cooroy, 4 km E of Cooroy, Apr 1986, *Sharpe 4322 & Guymer* (BRI). Moreton District. Mt Eerwah, 4 km W of Eumundi, Dec 1984, *Sharpe 3624* (BRI, L, MEL, NSW); Wappa Falls, South Maroochy River, *c.* 6 km SW of Yandina, Oct 1986, *Sharpe 4525 & Windolf* (BRI); Wappa Falls, Maroochy River, May 1959, *Smith 10545* (BRI); Yandina, Mar 1891, *Simmonds s.n.* (BRI [AQ183536]); 1 km S of Wappa Dam, SW of Yandina,

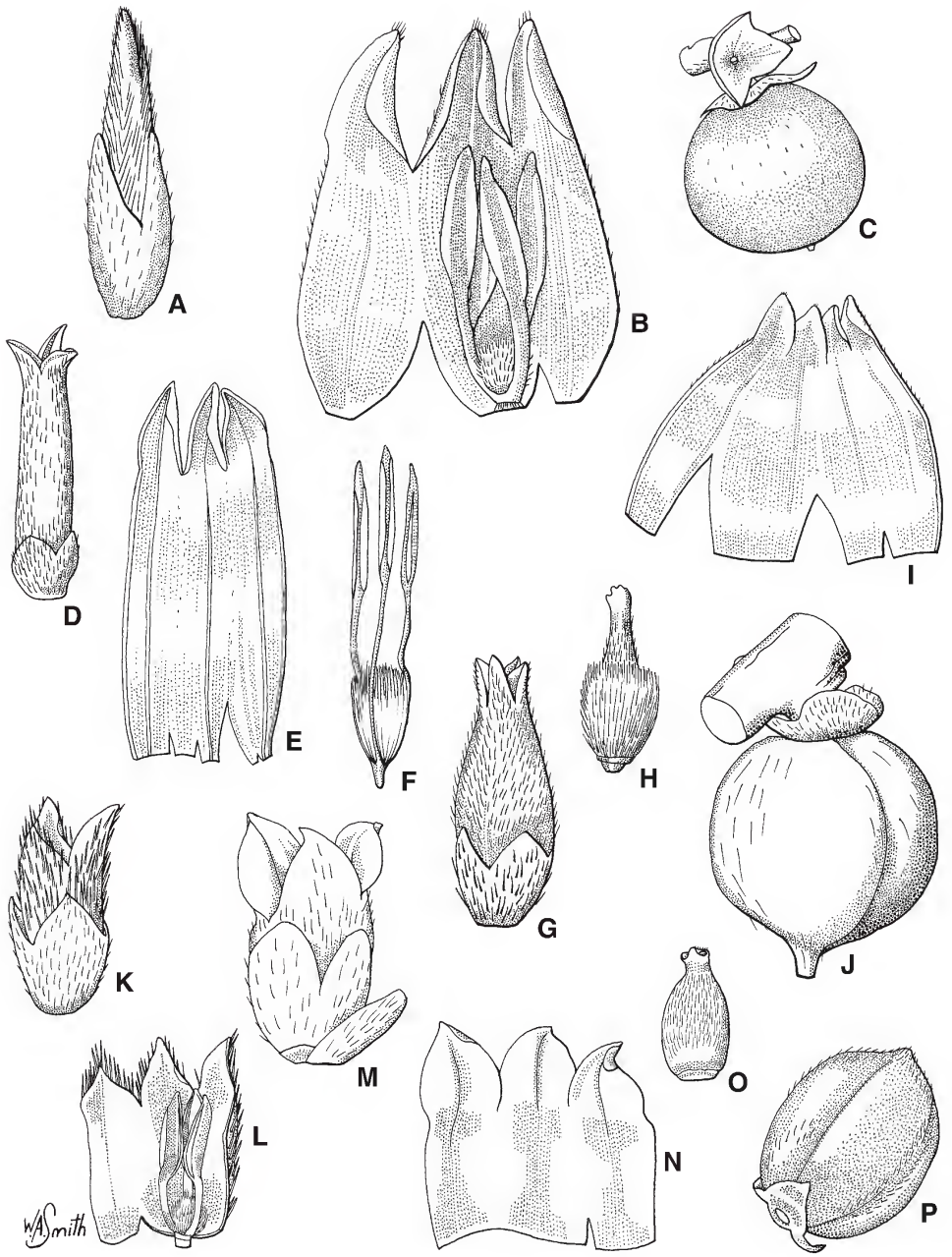

Fig. 5. A–C: ***Diospyros yandina***. A. male flower ×6. B. dissected corolla, stamens and pistillode ×8. C. fruit ×2. **D–J:** ***Diospyros peninsularis***. D. male flower ×4. E. corolla, male flower ×6. F. stamens and pistillode, male flower ×6. G. female flower ×6. H. dissected ovary, female flower ×6. I. dissected corolla, female flower ×6. J. fruit ×3. **K–P:** ***Diospyros pluviatilis***. K. male flower ×6. L. dissected male flower showing stamens and pistillode ×6. M. female flower ×6. N. dissected corolla, female flower ×6. O. dissected ovary, female flower ×6. P. fruit ×2. A, B from *Bird s.n.* (BRI [AQ396282]); C from *Jessup 430* (BRI); D–F from *Forster PIF6331*(BRI); G–I from *Forster PIF5442* (BRI); J from *Williams 85195* (BRI); K, L from *Gray 852* (BRI); M–O from *Jessup 708* (BRI); P from *Tracey 15551* (BRI).

Dec 1994, *Bean 8131* (BRI); Nambour – roadside park to N of town, Dec 1984, *Bird s.n.* (BRI [AQ396282]); Tuckers Creek, roadside rest area on highway just N of Nambour Dec 1980, *Jessup 272* (BRI); northern tributary of Petrie Creek, northern outskirts of Nambour, picnic area, just N of major intersection of Bli Bli – Mapleton Road, Dec 1986, *Beesley 889 & Ollerenshaw* (NSW); Andrew Doig Park, Murray Grey Drive, Maroochy Shire Council, 5 km WNW of Nambour, Dec 2006, *Forster PIF32363 et al* (BRI); William Doig Park, Murray Grey Drive, Maroochy Shire Council, 5 km WNW of Nambour, Dec 2006, *Forster PIF32389 et al.* (BRI); Murray Grey Drive, Dulong, west of Nambour, Dec 1993, *Bean 7212* (BRI); Buderim Mt, Apr 1916, *White s.n.* (BRI [AQ183529]). **New South Wales.** North Coast: Tumbulgum, Feb 1897, *Baeuerlen 1889* (BRI), Oct 1897, *Baeuerlen s.n.* (BRI [AQ625613]), Dec 1897, *Baeuerlen s.n.* (NSW), Jan 1898, *Baeuerlen s.n.* (NSW).

***Distribution and habitat*:** *Diospyros yandina* occurs from the Great Sandy NP, Cooloola section to Buderim Mt in southeast Queensland and in the Tweed River valley, NSW (**Map 9**), mostly in lowland notophyll vineforest.

***Phenology*:** Flowers have been recorded from December to February and fruit from October to May.

***Etymology*:** The species epithet commemorates the township of Yandina, Queensland where the earliest known collection of the species was made by J.H. Simmonds on 1 March 1891.

16. Diospyros peninsularis Jessup **sp. nov.**; resembling *D. yandina*, *D. hemicycloides* and *D. laurina* but differing in the midvein being raised on the upper surface of the lamina (not sunken), and differing from *D. yandina* in the fewer secondary veins (7–11 compared to 11–20), in the longer stamens (5–6 mm compared to 4–4.5 mm), and the longer style (c. 2 mm compared to less than 0.5 mm) and from *D. hemicycloides* in the fewer and longer stamens (up to 3 compared to 7–9, and 5–6 mm compared to 2–2.5 mm). It also differs from *D. laurina* in the much smaller and thinner calyx in both sexes and in fruit. **Typus:** Queensland. Cook District: N bank of Pascoe River approx. 1 km inland from river mouth, 21 November 1977, *J.G. Tracey 14396* (holo: BRI, iso: *distribuendi*).

Diospyros sp. (Kuranda L.J. Webb+ 7265A); Jessup (1994, 1997, 2002, 2007, 2010).

Diospyros sp. (Kuranda); Cooper & Cooper (2004: 156).

Diospyros sp. Bamaga (B.P.Hyland 2517) at http://keys.trin.org.au:8080/key-server/data/0e0f0504-0103-430d-8004-060d07080d04/media/Html/taxon/Diospyros_sp._Bamaga_(B.P.Hyland_2517).htm with respect to the description, images, and all specimens except the reference specimen. The reference specimen *Hyland 2517* is *Diospyros areolifolia*.

Diospyros sp. (Bamaga); Cooper & Cooper (2004: 156).

Shrub or tree to 10 m. Twigs with appressed or inclined submedifixed pale brown coarse hairs and minute erect hairs, glabrescent. Leaves: petiole 2.5–4 mm long, glabrescent; lamina elliptic, ovate or lanceolate, 3–10 cm long, 1–3 cm wide; base cuneate or rounded; glands small and sparse; margins slightly recurved and undulate; apex acute with a blunt tip; with scattered to sparse appressed or inclined hairs on both sides, glabrescent; midvein on upper surface raised, secondary veins mostly 7–11 pairs. **Male** inflorescence axes *c.* 1 mm long, 1– several fasciculate in leaf axils, pubescent, each usually terminating with 3 flowers, sessile or on pedicels to 1 mm, pubescent. Calyx tube 1–2.5 mm long, lobes 3, sometimes 4, connate at first then 1–2 mm long, acute, calyx appressed pubescent outside, hairs shorter and more sparse inside. Corolla tube 5–6 mm long, lobes mostly 3, ovate, 1.5–2 mm long, appressed pubescent or coarsely sericeous outside, glabrous inside. Stamens (2) or 3, 5–6 mm long, filaments not adnate to tube, glabrous, 2.5–3 mm long; anthers linear, 2.5–3 mm long; pistillode 0.5–0.8 mm long, pubescent. **Female** flowers solitary, peduncle 0.5–0.7 mm long, pubescent, bract and bracteoles 0.8–1 mm long, pedicel up to 0.2 mm long. Calyx tube 1.3–1.5 mm long, lobes 3(–4), broadly ovate, obtuse, 1–1.3 mm long, indumentum as in males. Corolla tube 4–4.5 mm long, lobes 3 or 4, navicular-ovate, 1.4–1.6 mm long, coarsely sericeous outside, glabrous inside. Staminodes absent. Ovary 2 mm long, coarsely sericeous, 2 or 3-locular, ovules 2 per locule, styles ± completely connate, to 2 mm long, stigmas 2 or 3. Fruiting calyx usually

flattened or recurved from base of fruit. Fruit globose or depressed globose, 8–10 mm long, 9–12 mm wide, glabrescent, reddish brown or orange, style remnant and surrounding hairs sometimes persisting, 1–4-seeded; seeds 5–8 mm long. **Fig. 5D–J.**

***Additional selected specimens examined*: Queensland.** Cook District: Moa [Island] in Torres Strait, May 2003, *Wannan 2904 & Toh* (BRI); Lockerbie (abandoned), Lockerbie Scrub, 5 km from old homestead site, N, on Cape York Road, Sep 1985, *Williams 85195* (BRI); Lockerbie Scrub, 3 km past Lockerbie Homestead, Feb 1990, *Forster PIF6331* (BRI); 47 km from the Cape York Road on the track to Ussher Point, Jul 1992, *Clarkson 9675 & Neldner* (BRI); Restoration Island, Apr 1995, *Le Cussan 303* (BRI); Stoney Point, N of Pascoe River, Nov 1977, *Tracey 14154* (BRI); Pascoe River mouth, north bank, 33.8 km NNW of Lockhart River, Bromley Holding, North East Cape York peninsula, Apr 1993, *Fell DGF3154 & Butcher* (BRI); Between Iron Range and Portland Roads, Oct 1972, *Dockrill 557* (BRI, L); Iron Range, Oct 1983, *Sankowsky 267 & Sankowsky* (BRI); Head of Swamp Creek, Table Range, 11.9 km S of Lockhart River community, Apr 1994, *Fell DGF4295 & Daunt* (BRI); Junie Creek, Oct 1972, *Dockrill 574* (BRI); Alligator Creek, Oct 1972, *Dockrill 588* (BRI, L); McIlwraith Range, *c.* 11 miles [17.6 km] ENE of Coen, Oct 1962, *Smith 11784* (BRI); 33.2 km E by road of Maloney's Springs, 73.2 km E by road of Moreton Telegraph Station, Jun 1989, *Forster PIF5442* (BRI); *c.* 6 km SSW of Cape Flattery township, May 1990, *Clarkson 8628 & Neldner* (BRI); Abor. Res. 1, between McIvor River & Cape Flattery, Nov 1972, *Hyland 6538* (BRI, L); Bridge Creek Holding (proposed NP), upper Bridge Creek catchment; NW of Cooktown, May 2010, *Forster PIF36683 & Thomas* (BRI); Carrol Creek road crossing, NW of Hopevale mission, Dec 1984, *Jessup 647* (BRI, L).

***Distribution and habitat*:** *Diospyros peninsularis* occurs on Cape York Peninsula, Queensland from near Cooktown to Torres Strait (**Map 9**), in several forms of semideciduous notophyll vine forest and araucarian vine thicket.

***Phenology*:** Flowers have been recorded from February to July, and fruit from July to December.

***Etymology*:** The species epithet refers to Cape York Peninsula where the majority of the specimens have been collected.

***Notes*:** The species described here is the same taxon as the reference specimen cited in the phrase name *Diospyros* sp. (Kuranda L.J. Webb+ 7265A) but the locality details (Smithfield–Black Mt road via Kuranda) provided on the label of the reference specimen are doubtful as no other specimens of this species have been found south of Carrol Creek near Cooktown.

17. Diospyros pluviatilis Jessup **sp. nov.**; resembling *D. yandina* but differing in the mostly larger leaves (3–5.5 cm wide compared to 1–3 cm wide), the more prominent secondary veins, more numerous flowers in the inflorescence and the persistent remnants of inflorescences on older branchlets. It differs from *D. hemicycloides* in the mostly more numerous flowers in each inflorescence and in the fewer stamens (3 or 4 compared to 7–9). **Typus:** Queensland. Cook District: Souita Falls – Middle Brook Creek Road, SE of Millaa Millaa, 11 November 1992, *J.G. Tracey 15551* (holo: BRI; iso: *distribuendi*).

Diospyros sp. (Millaa Millaa L.W. Jessup 515); Jessup (1994, 1997, 2002, 2007, 2010).

Diospyros sp. (Millaa Millaa); Cooper & Cooper (2004: 156).

***Illustration*:** Cooper & Cooper (2004: 156), as *D.* sp. (Millaa Millaa).

Shrub to 3 m. Twigs with appressed sub-basifixed hairs and short erect basifixed hairs, glabrescent. Leaves: petiole 3–5 mm long, glabrescent; lamina elliptic or lanceolate, 8–14 cm long, 3–5.5 cm wide; base cuneate or rounded; glands small and sparsely scattered on undersurface; margins flat; apex shortly acuminate; adaxial surface glabrous, abaxial surface glabrescent; midvein above depressed, secondary veins 9–13 pairs forming prominent loops well within the lamina margin. **Male** inflorescences cauline, fasciculate, forming clusters of 5–20 flowers; peduncles with persistent overlapping bracts and peduncles persistent on older branchlets. Calyx tube 1–1.5 mm long, lobes (2–)3, 1–2 mm long, bluntly acute, calyx appressed pubescent outside, glabrous inside. Corolla tube 1.5–2 mm long, lobes 3, triangular, 1.5–2 mm long, appressed pubescent outside, glabrous inside. Stamens 3 or 4, 2.5–3 mm long, filaments attached below base of pistillode, not adnate to corolla tube, glabrous, 0.75–1 mm long; anthers linear, 1.7–2 mm long; pistillode *c.* 0.6 mm long, pubescent.

Female flowers 1–3 together, peduncles 1–1.5 mm long with persistent overlapping bracts and the peduncles persistent on older branchlets. Calyx tube 1.2–2.4 mm long, lobes (2–)3, connate in bud, 2–2.5 mm long, bluntly acute, calyx appressed pubescent outside, glabrous inside. Corolla tube 2–2.5 mm long, lobes 3, triangular, 2.4–2.6 mm long, appressed pubescent outside, glabrous inside. Staminodes absent. Ovary 1.8–2 mm long, sericeous, 3-locular, ovules 2 per locule, style 0.5–0.75 mm long, with appressed hairs at base, stigmas bifid. Fruiting calyx trilobed, 5–8 mm diameter, scarcely appressed to base of fruit, the lobes spreading or recurved, fruit globose or broadly ellipsoid, 10–15 mm long, 9–13 mm wide, with scattered appressed hairs, glabrescent; seeds 8–10 mm long. **Fig. 5K–P.**

***Additional selected specimens examined*: Queensland.** Cook District: NPR 133, Daintree, above tributary of Mackenzie Creek, WNW of Mt Hutchinson, Sep 2002, *Ford AF3601 & Holmes* (BRI); S of junction of E & W Mulgrave Rivers, SFR 310, Goldfield LA, 20.1 km SSE of Little Mulgrave township, Nov 1988, *Jessup GJM1663 et al.* (BRI); NE slopes of Bartle Frere, in 1995, *Hunter JH2151* (BRI); TR1230, Boonjee LA, Nov 1977, *Gray 772* (BRI, CNS); *loc. cit.*, Jan 1978 *Gray 852* (BRI, CNS); Mt Bartle Frere, 1.8 km WSW of Bobbin Bobbin Falls, 4.4 km NNE Boonjee, Nov 1988, *Jessup GJM1036 et al.* (BRI); Stockwellia track, Wooroonooran NP, Dec 1998, *Forster PIF24054 et al.* (BRI); SFR 755 Gosschalk LA, May 1976, *Hyland 8795* (BRI, CNS); The Boulders, North Babinda Creek, W of Babinda, Dec 1984, *Jessup 708* (BRI); SFR 755, Barong LA, Francis Range, Dec 1984, *Jessup 715 & 716* (BRI); 1.4 km SE of Cooroo Peak at the head of Culla Creek 14 km NW of South Johnstone, Oct 1988, *Jessup GJM2551 et al.* (BRI); Junction of Duffer Creek & Johnstone River, Jul 1992, *Tucker & Sankowsky s.n.* (BRI [AQ547363]); SF 756 Mt Father Clancy, May 2000, *Forster PIF25722 & Booth* (BRI); North Johnstone River, near Palmerston NP, Nov 1982, *Jessup 517* (BRI); Palmerston NP, North Johnstone River, Dec 1984, *Jessup 741* (BRI); Palmerston NP, Tchupalla Falls track, Nov 1982, *Jessup 515* (BRI); Kaaru LA, SW corner 14.5 km SSE of Millaa Millaa, Oct 1988, *Jessup GJM2016 et al.* (BRI); SFR 756 Jordon, Lower Downey LA, Dec 1991, *Gray 5388* (BRI, CNS), *Gray 5389* (BRI, CNS), *Gray 5394* (BRI, CNS); Elinjia LA, 7.4 km NE of Millaa Millaa, Oct 1988, *Jessup GJM2130 et al.* (BRI); Gregory Falls, Lower Palmerston via Innisfail, in 1962, *Webb & Tracey 6680B* (BRI); Mena Creek, Oct 1995, *Gleed s.n.* (BRI [AQ585232]); Liverpool Creek W of Silkwood, Dec 1984, *Jessup 738* (BRI).

***Distribution and habitat*:** *Diospyros pluviatilis* is endemic to northeast Queensland, occurring from near Mt Hutchinson north of the Daintree River and in the area approximately bounded by the upper reaches of the Mulgrave River, Bellenden Ker township, Mena Creek, Liverpool Creek and Millaa Millaa (**Map 10**), in complex mesophyll or notophyll vineforest, on alluvium or basalt soil.

***Phenology*:** Flowers have been recorded from October to February, and fruit from October, November and May.

***Etymology*:** The species epithet is a Latin adjective meaning 'relating to rain' and refers to the natural distribution of this species being within areas of the Wet Tropics recording some of the highest rainfall averages in Australia.

18. Diospyros rheophila Jessup **sp. nov.**; it differs from all other Australian species in its rheophytic habit and leaf lamina length 4–6 times width. **Typus:** Queensland. Cook District: Timber Reserve 165, Baird Logging Area, 22 September 1980, *B. Hyland 10623* (holo: BRI).

Diospyros sp. (Baird L.A. B.Hyland 9374); Jessup (1994, 1997, 2002, 2007, 2010).

Diospyros sp. (Baird LA); Cooper & Cooper (2004: 156).

Shrub or tree to 5 m. Twigs with appressed submedifixed hyaline or pale brown hairs, glabrescent. Leaves: petiole 3–4 mm long, flat above, glabrescent; lamina narrowly oblanceolate or narrowly elliptic, 4.3–8 cm long, 1.1–1.4(–1.7) cm wide; base cuneate; glands 2–6 on basal quarter of lamina below; margins slightly recurved; apex rounded or bluntly acute; glabrous above, sparsely appressed pubescent with submedifixed hairs below, glabrescent; midvein more or less flush above, secondary veins 5–10 pairs, often difficult to distinguish from higher order veins. **Male** flowers not seen. **Female** flowers solitary, peduncle 1–2 mm long, pubescent, with caducous bracts. Calyx 3.5–4 mm long, tube 1.5–2 mm long, lobes 3, connate at first then 1.5–2 mm long, mostly obtuse, calyx appressed pubescent, glabrescent outside, appressed pubescent inside. Corolla tube 2–3 mm long, lobes 3, ovate, 2–2.5 mm long, appressed pubescent or coarsely sericeous

outside in the middle of the lobes, glabrous below and inside. Staminodes absent. Ovary 1.7–2 mm long, sericeous, 3-locular, ovules 2 per locule, style 0.75–1 mm long, pubescent at base, stigmas bifid. Fruit not seen. **Fig. 6A&B.**

***Additional selected specimens examined*: Queensland.** Cook District: TR 165, Alexandra LA, Jun 1977, *Hyland 9374* (BRI); TR 106, Parish of Noah, Baird LA, Roaring Meg Creek, Jul 1997, *Hyland 26021RFK* (BRI).

***Distribution and habitat*:** *Diospyros rheophila* is endemic to northeast Queensland growing as a rheophyte amongst rocks and boulders in notophyll vineforest along Roaring Meg Creek, north of Daintree (**Map 10**).

***Phenology*:** The species flowers in September.

***Etymology*:** The specific epithet is from Greek *rheophilus*, loving rivers, in reference to the apparent preferred habitat of the species.

19. Diospyros granitica Jessup **sp. nov.**; allied to *D. pentamera* but differing in the leaf lamina not discolorous and papillate below and the fruiting calyx fully appressed to the base of the fruit with inconspicuous lobes compared to the fruiting calyx with lobes 2–4 mm long and often recurved in *D. pentamera*. **Type:** Queensland. Cook District: State Forest Reserve 143, Kanawarra, Carbine Logging Area, 21 December 1988, *B. Hyland 13792* (holo: BRI [2 sheets]).

Diospyros sp. (Mt. Spurgeon C.T. White 10677); Jessup (1994, 1997, 2002, 2007, 2010).

Diospyros sp. (Mt Spurgeon); Cooper & Cooper (2004: 156).

Tree to 15 m. Twigs with appressed long and short basifixed pale brown hairs, glabrescent. Leaves: petiole 3–6 mm long, glabrescent; lamina elliptic, 5–7(–9) cm long, 2–3.8 cm wide; base shortly attenuate; glands mostly 3–8 on basal quarter of lamina below; margins slightly recurved near base; apex acuminate; sparsely appressed pubescent, glabrescent both sides; midvein on upper surface depressed, secondary veins 7–11 pairs, sometimes indistinct, highest order veins ± parallel. **Male** inflorescence axes solitary or several in axillary fascicles, 1.5–4 mm long, each with 3–5 flowers, appressed pubescent. Calyx tube 1–1.5 mm long, lobes 4 or 5, 1–1.2 mm long, acute or obtuse; calyx appressed pubescent outside and at base inside. Corolla tube 1.5–1.7 mm long, lobes 4 or 5, broadly ovate, 2.5–2.7 mm long, appressed sericeous outside except margins, appressed puberulous inside. Stamens mostly (15–)16(–17), 3.5–4 mm long, filaments connate at base in pairs and adnate to corolla tube at base, 1.8–2 mm long, pilose just below the anther, the longer hairs as long as the anthers; anthers narrowly ovate, acuminate, 1–1.3 mm long; pistillode *c.* 1 mm long, puberulous towards apex. **Female** flowers often 3 in each axil, each on a pubescent peduncle 2–4 mm long, bracts *c.* 1 mm long, caducous. Calyx tube 2.5 mm long, lobes 4 or 5, 1 mm long, acute or obtuse; calyx appressed sericeous outside and inside, puberulous along lobe margins. Corolla tube *c.* 1.5 mm long, glabrous outside and inside, lobes 4 or 5, 2–2.5 mm long. Staminodes 6–10, like stamens with vestigial anthers, filaments not paired. Ovary 2.5 mm long, sericeous, 3–5-locular, ovules 2 per locule, styles 3–5, 1.5–1.7 mm long, distally free and glabrous just below the lobed stigmas, otherwise appressed pubescent. Fruiting calyx cupular, 8–9 mm diameter, appressed to base of fruit, lobes broadly triangular, indistinct or scarcely visible; fruit obovoid, ellipsoid or subglobose, 10–18 mm long, 10–13 mm wide, glabrescent; mostly 1-seeded; seeds 9–10 mm long. **Fig. 6C–H.**

***Additional selected specimens examined*: Queensland.** Cook District: Mt Spurgeon, Sep 1937, *White 10677* (BRI); *loc. cit.*, Nov 1985, *Godwin C2923* (BRI); Near Schillers Hut, Mt Spurgeon, Sep 1972, *Webb & Tracey 11779* (BRI); 32.5 km along Mt Lewis Road from Mossman – Mt Molloy Road, Dec 1989, *Jessup GJD3366 et al.* (BRI); Mt Lewis Road, S Mary LA, 16 km NNW Mt Molloy, Nov 1988, *Jessup GJM1554 et al.* (BRI), *Jessup GJM1497 et al.* (BRI); SFR 143, Riflemead, Carbine LA, Oct 1988, *Hyland 13587* (BRI), Dec 1988, *Hyland 13798* (BRI), Nov 1987, *Hyland 25237RFK* (BRI), Dec 1988, *Hyland 25628RFK* & *25627RFK* (BRI); SFR 143, Parish of Riflemead, Carbine LA, Jul 1988, *Gray 4896* (BRI); SFR 143, Kanawarra, Carbine LA, Dec 1988, *Hyland 13792* (BRI); Mt Lewis, Oct 1971, *Webb & Tracey 10530* (BRI); Mt Bartle Frere, Oct 1891, *Johnson s.n.* (MEL 233340); *loc. cit.*, Jan 1891, *Johnson s.n.* (MEL 233339); Upper Russell River, Jan 1891, *Johnson s.n.* (MEL233337); Mt Bartle Frere, in 1892, *Johnson s.n.* (BRI [AQ519813]); Wooroonooran NP, East Mulgrave River, Nov 2000, *Forster PIF26441 et al.* (BRI); E Bartle Frere, Nov 1994, *Hunter JH1840* (BRI).

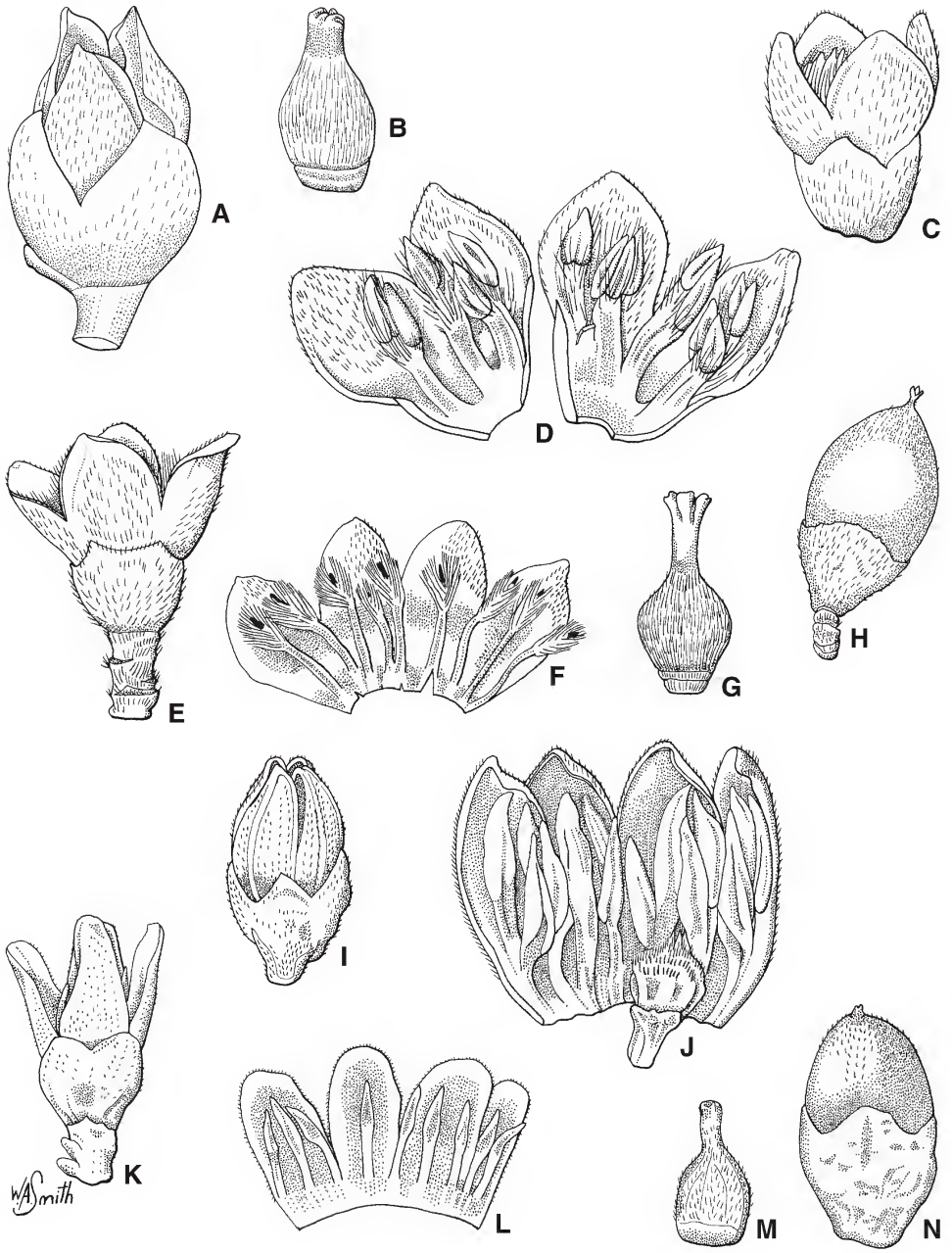

Fig. 6. A, B: *Diospyros rheophila*. A. female flower ×6. B. dissected ovary, female flower ×6. **C–H: *D. granitica*.** C. male flower ×6. D. dissected male corolla and stamens ×8. E. female flower ×4. F. dissected female corolla showing staminodes ×4. G. dissected ovary, female flower ×6. H. fruit ×2. **I–N: *D. australis*.** I. male flower in late bud ×6. J. dissected male flower showing stamens and pistillode ×8. K. female flower ×4. L. dissected corolla showing staminodes, female flower ×4. M. dissected ovary, female flower ×4. N. fruit ×2. A, B from *Hyland 10623* (BRI); C & D from *Hyland 25628RFK* (BRI); E–G from *Hyland 13792* (BRI); H from *Hyland 13587* (BRI); I from *Volck s.n.* (BRI [AQ13088]); J from *Hoy 162* (BRI); K from *Stanley 78179 & Ross* (BRI); L & M from *Grimshaw G286 & Franks* (BRI); N from *Gibson TOI491* (BRI).

***Distribution and habitat*:** *Diospyros granitica* is endemic to northeast Queensland occurring between Mt Spurgeon and Mt Lewis and also on the slopes of Mt Bartle Frere (**Map 11**). It is found in notophyll and microphyll vine-fern forest on granite.

***Phenology*:** Flowers have been recorded in November and December and fruit from July to December.

***Etymology*:** The specific epithet refers to the granite-derived soils in which this species grows.

20. Diospyros australis (R.Br.) Hiern, *Trans. Cambridge Philos. Soc.* 12: 30 (1873); *Cargillia australis* R.Br., *Prodr.* 527 (1810). **Type:** New South Wales. Port Jackson, Hawkesbury, Hunter's River, *s.dat.*, *R. Brown iter Austral. 2828* (syn: BM, E, K).

Maba cargillia F.Muell., *Fragm.* 5: 162 (1866), *pro syn. nom. inval.*, *nom. nud.*

Diospyros cargillea F.Muell., *Austral. Veg.* 35 (1867) *nom. inval.*, *nom. nud.*

Diospyros cargillia F.Muell. ex Hiern *nom. illeg.*, *nom. alt.*; Hiern, *Trans. Cambridge Philos. Soc.* 12: 77, 155, 246, 290, 292 (1873).

Annona microcarpa Jacq., *Fragm. Bot.* 40, t.44 (1800–1809); *Diospyros microcarpa* (Jacq.) Gürke (1890), *nom. illegit., non D. microcarpa* Span. (1836) *et non D. microcarpa* Siebold (1844).

Tree to 30 m. Twigs appressed pubescent with basifixed hairs. Leaves: petiole 3–8 mm long, channelled above, appressed pubescent; lamina oblong, elliptic or narrowly ovate, 3–12 cm long, 1–3.5 cm wide; base cuneate; glands 1–8(–16) on basal half of lamina below; margins sometimes recurved; apex often obtuse or rounded; glabrescent and soon glabrous above, appressed pubescent and minutely papillate below appearing dull pale green; midvein on upper surface shallowly depressed; secondary veins 7–11 pairs, indistinct below. **Male** inflorescence axes solitary or several in axillary fascicles, 1.5–4 mm long, each with 3–5 flowers, appressed pubescent. Calyx tube 2.5–3 mm long, lobes 4, 0.5–0.7 mm long, obtuse; calyx appressed pubescent outside, glabrous inside. Corolla tube 1.5–1.6 mm long, lobes 4, ovate or oblong, 4–5 mm long, appressed pubescent outside, glabrous inside. Stamens 12–16, 3–4 mm long, filaments connate at base in pairs and adnate to corolla tube at base, 1–2 mm long, glabrous; anthers narrowly lanceolate, 2–2.5 mm long, glabrous; pistillode *c.* 2 mm long, pubescent, with glabrous rudimentary styles. **Female** flowers 1–3 in each axil, each on a pubescent peduncle to 2.5 mm long, bracts navicular, 2–3 mm long, caducous. Calyx tube 2.5–3 mm long, lobes 4, 1–1.3 mm long, acute or obtuse; calyx appressed pubescent outside and inside on lobes. Corolla tube 1.5–1.7 mm long, glabrous outside and inside, lobes 4–6, oblong, 3.5–4.5 mm long. Staminodes 8–15, like stamens with sterile anthers, filaments not paired. Ovary 2.5–3 mm long, sericeous, 4-locular, ovules 2 per locule, style 1.5–1.7 mm long, appressed pubescent but glabrous just below the lobed stigmas. Fruiting calyx cupular, 10–12 mm diameter, appressed to base of fruit, lobes broadly triangular, *c.* 2 mm long; fruit ovoid or subglobose, 11–14 mm long, 9–10 mm wide, appressed pubescent; mostly with 1 seed; seeds 7–8 mm long. **Fig. 6I–N.**

***Additional selected specimens examined*: Queensland.** Cook District: Candlenut Scrub, SF 144 Mt Windsor Tableland, Nov 1997, *Forster PIF21883 et al.* (BRI); Danbulla, R185, Oct 1953, *Volck s.n.* (BRI [AQ13088]); SFR 194, Sylvia LA, NE of Walsh Falls, Sep 1998, *Ford 2104* (BRI). North Kennedy District: Mount Aberdeen NP, 40 km inland from Bowen, Mar 1989, *Fell DF1822* (BRI). South Kennedy District: Dalrymple Heights and vicinity, Sep–Nov 1947, *Clemens s.n.* BRI [AQ183475]). Port Curtis District: 2.5 km SW of Raglan, R146, Horrigan Creek, Mar 1989, *Gibson TOI491* (BRI); 20 km from Agnes Water, S of Gladstone, Nov 1978, *Stanley 78179 & Ross* (BRI). Leichhardt District: Buckland Creek, Carnarvon Range, *s.dat.*, *Jensen s.n.* (BRI [AQ183462]). Maranoa District: Carnarvon NP, Mount Moffatt Section, gully to the north of Marlong Plain, Nov 1996, *Eddie 19* (BRI). Burnett District: Cania Gorge NP, along track to Dripping Rock, Oct 1999, *Halford Q3858* (BRI); Mt Walsh NP, track to Coongara Rock, 15 km SSW of Biggenden, Coast Range, Nov 2007, *Forster PIF33148* (BRI); 6 km NNW of Coalstoun Lakes, Apr 1991, *Forster PIF7848* (BRI); Bunya Mountains, between Noolers Lookout & Mt Kiangarow, Dec 1954, *Smith 6256* (BRI). Wide Bay District: 1 km SW of Booyal, Childers, Nov 1987, *Forster PIF3294* (BRI); Jimna Range Road, Kilcoy to Goomeri, north of Jimna township, Dec 1993, *Grimshaw G286 & Franks* (BRI). Darling Downs District: Mt Colliery

to Gambubal Road, western fall of the Main Range, NE of Killarney, Jan 2012, *Forster PIF38565 & Leiper* (BRI). Moreton District: Riverside Drive near Ipswich Mining Museum, Raymonds Hill near Coal Creek, Mar 1994, *Grimshaw G514* (BRI); Black Rock Creek scrub, 13 km S of Boonah, Mar 1991, *Forster PIF7815* (BRI). **New South Wales.** North Coast: Nymboida River, near Bibiranga Road, 11 km S of Nymboida, May 1994, *Bean 7726* (BRI); Beecroft Peninsula, 6.3 km NNW of Point Perpendicular, S end of Long Beach, Dec 1988, *Winsbury 86 et al.* (BRI); Bolaro Mountain Road, 9 km from Kings Highway, Feb 1988, *Richardson 153 et al.* (BRI).

***Distribution and habitat*:** *Diospyros australis* occurs in eastern Australia, from Mt Windsor Tableland, northeast Queensland to near Batemans Bay, NSW, also inland at Carnarvon Gorge and vicinity in Queensland (**Map 12**), mostly in microphyll to notophyll vine forest on a variety of soil types.

***Phenology*:** Flowers have been recorded from August to December and fruit from January to September.

21. Diospyros pentamera (Woolls & F.Muell. ex F.Muell.) F.Muell., *Austral. Veg.* 35 (1867); *Cargillia pentamera* Woolls & F.Muell. ex F.Muell., *Fragm.* 4: 82 (1864). **Type:** New South Wales. Clarence River, *s.dat.*, *C. Moore s.n.* (lecto [here designated]: MEL 232965).

Cargillia arborea A.Cunn. ex Hiern, *Trans. Cambridge Phil. Soc.* 12: 239 (1873), *nom. inval., pro. syn.*

***Illustration*:** Cooper & Cooper (2004: 156).

Tree to 35 m. Twigs with appressed long basifixed pale brown hairs, glabrescent. Leaves: petiole 2–6 mm long, glabrescent; lamina elliptic or lanceolate, 3–10 cm long, 1–4 cm wide; base attenuate; glands mostly 2–10 on lamina below; margins slightly recurved near base; apex acuminate; sparsely appressed pubescent, glabrescent both sides, minutely papillate below appearing dull pale green and discolorous; midvein on upper surface depressed; secondary veins 7–11 pairs, sometimes indistinct. **Male** inflorescence axes solitary or few in leaf axils, each axis 4–12 mm long, each with 3–10 flowers, appressed pubescent. Calyx tube 1.5–1.7 mm long, lobes (4–)5(–6), 1.2–1.4 mm long, acute; calyx appressed pubescent outside, glabrous inside. Corolla tube 1.5–1.7 mm long, lobes mostly 5, narrowly ovate or oblong, 3–3.5 mm long, appressed pubescent outside but glabrous on the overlapped margin and inside. Stamens 15–20, 3.7–4.5 mm long, filaments connate at base in pairs or alternipetalous ones sometimes single and adnate to corolla tube at base, 1–2 mm long, glabrous towards base, pilose just below anthers; anthers linear-rostellate, 2.5–3 mm long, connective pilose; pistillode *c.* 1 mm long, pubescent. **Female** flowers 1(–3) in each axil, each on a pubescent peduncle 1.5–5 mm long, bracts caducous. Calyx tube 2.5–3 mm long, lobes (4–)5, 2–2.5 mm long, obtuse; calyx appressed pubescent outside and inside. Corolla tube 1.5–2.2 mm long, glabrous outside and inside, lobes (4–)5, oblong or narrowly ovate, 3–3.8 mm long. Staminodes 10–12, like stamens with sterile anthers, filaments single or paired. Ovary 2–2.5 mm long, sericeous, 3-locular, ovules 2 per locule, style 1.7–2 mm long, appressed pubescent, 3-branched for nearly half its length and glabrous just below the stigmas. Fruiting calyx cupular, 10–12 mm diameter, appressed to base of fruit, lobes broadly triangular, 2–4 mm long; fruit ovoid or subglobose, 14–18 mm long, 10–15 mm wide, appressed pubescent, glabrescent, 1–4-seeded; seeds 8–12 mm long. **Fig. 7A–F.**

***Additional selected specimens examined*: Queensland.** Cook District: Daintree NP, Adeline Creek headwaters, Candlenut scrub, May 1999, *Forster PIF24569 & Booth* (BRI); SFR 144 Mt Windsor Tableland, Oct 1979, *Moriarty 2685* (BRI); SFR 607, Parish of Cairns, Shoteel LA, Sep 1986, *Gray 4359* (BRI). North Kennedy District: Scrubby Creek, Herberton Range, Nov 1929, *Kajewski 1359* (BM, BRI); Mt Fox, Nov 1949, *Clemens s.n.* (BRI [AQ416986]); Mt Aberdeen NP, west of Bowen, May 1992, *Forster PIF9964 et al.* (BRI). South Kennedy District: SF 679 Crediton, Clarke Range, Apr 2000, *Forster PIF25525* (BRI). Port Curtis District: Resumption LA, SF 391, Bulburin, Dec 1993, *Forster PIF14521 et al.* (BRI). Wide Bay District: *c.* 2 km from Dundowran Beach on road to Hervey Bay, Nov 1978, *Stanley 78125 & Ross* (BRI); Mary River Heads, Pialba, Nov 1987, *Forster PIF3458 et al.* (BRI); top of Woowoonga Range, *c.* 15 km NE of Biggenden, Jun 1979, *Young 201 & Randall* (BRI). Burnett District: Dripping Rock, Cania Gorge NP, Mar 1997, *Kampf et al. s.n.* (BRI); roadside opposite entrance to Paradise Falls carpark, Bunya Mountains NP, Dec 2008, *Young 2412* (BRI). Moreton District: Brolga Park, Dulong Road, *c.* 6 km SW of Nambour, Dec 1989, *Sharpe 4928 & Bean* (BRI); Wards Scrub, W of Samford near headwaters of South Pine River, Dec 1983, *Jessup 578 & Guymer* (BRI); Beechmont Ridge, Beechmont, Macpherson Range, Oct

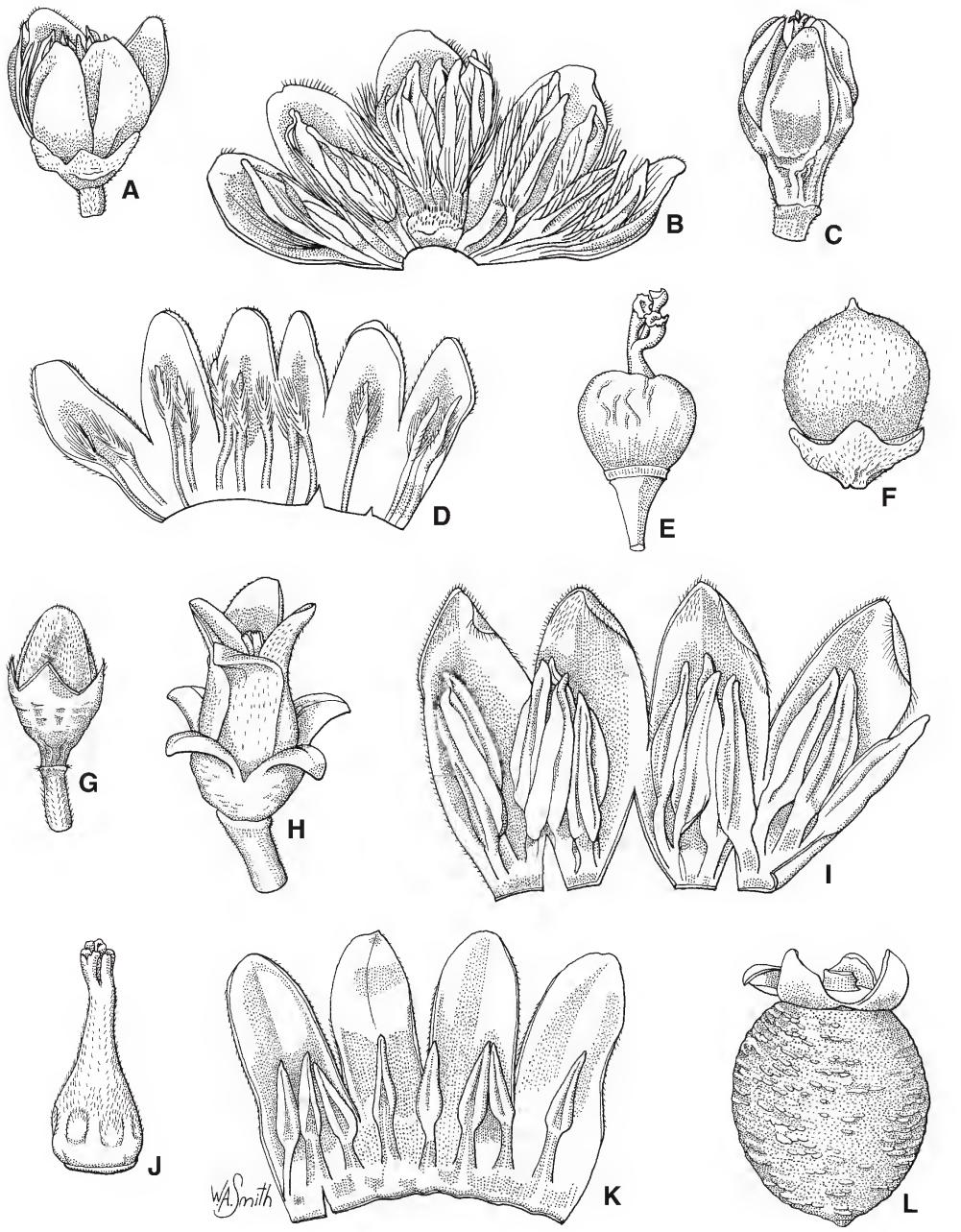

Fig. 7. A–F: ***Diospyros pentamera***. A. male flower ×4. B. dissected corolla showing stamens and pistillode, male flower ×6. C. female flower ×4. D. dissected corolla showing staminodes, female flower ×6. E. dissected ovary, female flower ×6. F. fruit ×2. **G–L:** ***Diospyros mabacea***. G. male flower bud ×4. H. female flower ×3, I. dissected corolla showing stamens, male flower ×8. J. dissected ovary, female flower ×4. K. dissected corolla showing staminodes, female flower ×4. L. fruit ×1.5. A, B from *Stanley 78125 & Ross* (BRI); C from *Jessup 578 & Guymer* (BRI); D from *Forster PIF3458 et al.* (BRI); E from *Smith 3618 & Webb* (BRI); F from *Grimshaw G84* (BRI); G, H from *Baeuerlen 1531* (BRI); I–K from *Murray s.n.* (BRI [AQ651258]); L. reconstructed from *Baeuerlen 1531* (BRI) and unvouchered photo.

1969, *Schodde 5590* (BRI); O'Reilly's, Lamington NP, May 1948, *Smith 3618 & Webb* (BRI); Qld/NSW border fence reserve near 'Wild Mountain' property, Levers Plateau, Oct 1993, *Grimshaw G84* (BRI). **New South Wales.** North Coast: Glenugie Peak, *c.* 12 miles [20 km] SE of Grafton, Nov 1965, *Constable 6408* (BRI); Dorrigo SF, Oct 1930, *White 7512* (BRI). Central Coast: 3 miles [4.8 km] W of Kiama on Jamberoo Road, Illawarra District, Mar 1964, *Schodde 3474* (BRI).

***Distribution and habitat*:** *Diospyros pentamera* is endemic to the eastern coast of Australia, south of Cape Tribulation, northeast Queensland to south of Kiama, New South Wales (**Map 13**). It occurs in various types of rainforest from sea level to at least 1100 m altitude.

***Phenology*:** Flowers have been recorded from September to May and fruit from February to July, also October and December.

22. Diospyros mabacea (F.Muell.) F.Muell., *Syst. Census of Austral. Pl.* 92 (1883); *Cargillia mabacea* F.Muell., *Fragm.* 5: 162 (1866). **Type:** New South Wales. Tweed River, *s.dat.*, *C. Moore s.n.* (holo: MEL 92384; iso: K 792758).

Tree to 25 m. Twigs with erect or antrorse basifixed pale brown hairs, glabrescent. Leaves: petiole 3–8 mm long, glabrescent; lamina narrowly elliptic or oblanceolate, 6–16 cm long, 2–5 cm wide; base shortly attenuate; margins recurved near base; glands mostly 2–10 scattered on lamina below; apex acuminate; glabrous above except main veins, sparsely appressed pubescent, glabrescent below; midvein on upper surface depressed, secondary veins 9–13 pairs. Male inflorescence a fascicle of cymes, each axis 3–4 mm long, each fascicle with up to 6 flowers, pubescent, bracts narrowly ovate, persistent. Calyx tube 2–2.3 mm long, lobes 4, 0.7–1.2 mm long, acute or obtuse; calyx sparsely appressed pubescent, glabrescent outside, glabrous inside. Corolla tube 2–2.5 mm long, lobes 4, narrowly ovate or oblong, 3.5–4 mm long, appressed pubescent outside but glabrous on the overlapped margin and inside. Stamens 15 or 16, 4–4.5 mm long, filaments connate at base in pairs and adnate to corolla tube at base, 1–1.5 mm long, glabrous; anthers subulate, 2.4–2.8 mm long, glabrous or with a few short hairs on the connective; pistillode *c.* 1 mm long, pubescent. Female flowers 1(–3) in each axil, each on a pubescent peduncle 4–6 mm long, bracts oblong, persistent. Calyx tube 2.5–3 mm long, lobes 4, 4–4.5 mm long, obtuse; calyx sparsely appressed pubescent outside, glabrous inside. Corolla tube 2–3 mm long, glabrous outside and inside, lobes 4, oblong, 6–7 mm long, apex rounded, recurved. Staminodes 8, like stamens with sterile anthers, filaments single. Ovary 3–3.7 mm long, appressed pubescent, 4-locular, ovules 2 per locule, style 3–4 mm long, appressed pubescent, but glabrous and scarcely branched below the stigmas. Fruiting calyx with recurved lobes 5–6 mm long; fruit ovoid, narrowly ovoid or ellipsoid, 25–45 mm long, glabrescent, 2–6-seeded; seeds 17–20 mm long. **Fig. 7G–L.**

***Additional selected specimens examined*: New South Wales.** North Coast: Murwillumbah, Oct 1896, *Baeuerlen 1531* (BRI, NSW); Oxley River, Tyalgum Showground, Dec 1983, *Floyd AGF2029* (BRI, NSW); 6 km NW of Tyalgum, 300 m NW beyond end of Butlers Road, Feb 1990, *Davies 1553a & Richardson* (BRI); Oxley River Middle Arm Creek, just beyond end of Butlers Road, NW of Tyalgum, Jul 1981, *Guymer 1586 & Jessup* (BRI, CANB, NSW); Oxley River tributary, Eungella, Dec 1983, *Floyd AGF2030* (BRI, NSW); Portion 23, Parish of Chillingham on E bank of Hopping Dicks Creek, Oct 1996, *Murray s.n.* (BRI [AQ651258], NSW); Murwillumbah, Sep 1900, *Campbell s.n.* (NSW 26402), Nov 1900, *Campbell s.n.* (NSW 274846), Mar 1901 *Campbell s.n.* (NSW 274851); Tweed River District, Oct 1901, *Campbell s.n.* (BM); Tweed River, North Arm, Mar 1917, *Runners s.n.* (NSW); main arm of Brunswick River, *c.* 3 km W of Mullumbimby, Feb 1998, *O'Donovan s.n.* (NSW).

***Distribution and habitat*:** *Diospyros mabacea* is restricted to northeast New South Wales, occurring in the Tweed and Brunswick River valleys (**Map 11**). The species is found in lowland complex notophyll vine forest.

***Phenology*:** Flowers and fruit have been recorded in October.

***Notes*:** *Diospyros mabacea* is listed as **Endangered** under the Environment Protection and Biodiversity Conservation Act 1999 and the NSW Threatened Species Conservation Act 1995.

Excluded names

Diospyros cordifolia Roxb., *Pl. Coromandel* 1: 38, t. 50 (1795).

Australian specimens referred to this name by Bentham (1868: 286) are *D. rugosula.*

Diospyros ellipticifolia (Stokes) Bakh., *Gard. Bull. Straits Settlem.* 7: 162 1933); *Ferreola ellipticifolia* Stokes, *Bot. Mat. Med.* 4: 556 (1812), *nom. illeg. et nom. superfl. pro Maba elliptica* J.R.Forst. & G.Forst., *Char. Gen. Pl.,* ed. 2. 122, t. 61 (1776); *Ebenus elliptica* (J.R.Forst. & G.Forst.) Kuntze, *Revis. Gen. Pl.* 2: 408 (1891).

Smith (1971) noted that *Ferreola ellipticifolia* Stokes is an illegitimate name because it was published with *Maba elliptica* J.R.Forst. & G.Forst. in synonymy. However, he then used the illegitimate combination *D. elliptica* (J.R.Forst. & G.Forst.) P.S.Green (a later homonym of *D. elliptica* Knowlt. (Dorr 2011). Australian specimens identified as this species (as the f. *australiensis*) by Bakhuizen van den Brink (1941: 65, 429) are referrable to *D. yandina.*

Diospyros ferrea (Willd.) Bakh., *Gard. Bull. Straits Settlem.* 7: 162 (1933); *Ehretia ferrea* Willd., *Phytographia* 4 (1794).

Bakhuizen van den Brink (1941: 57) stated "inter tropicos Africae, Asiae et Australiae dispersa"; however, no Australian specimens were actually cited. Bakhuizen van den Brink used species rank taxa to be all encompassing, with the actual taxa that could be related to species in a modern sense, usually circumscribed as varieties or forma.

Diospyros ferrea f. *lamponga* (Miq.) Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 434, 440 (1941); *Maba lamponga* Miq., *Fl. Ned. Ind., Eerste Bijv.* 3: 584 (1861).

Bakhuizen van den Brink (1941: 434) stated 'Habitat in Australia ore tropicali et in Insulindie'; however, no Australian specimens were actually cited.

Diospyros longipes Hiern, *J. Bot.* 52: 338 (1914). **Type citation:** "Townsville, Queensland, 11 Aug. 1913, R.H. Cambage".

Bakhuizen van den Brink (1941: 49) referred this material to *Mimusops elengi* L. (Sapotaceae).

Diospyros major (G.Forst.) Bakh., *Bull. Jard. Bot. Buitenzorg* ser. 3, 15: 429 (1941), *adnot. Maba major* G.Forst.

This was proposed by Bakhuizen van den Brink (1941: 429) as an alternative name to *D. ellipticifolia* (Stokes) Bakh. (see above). The name was misapplied by Jacobs & Pickard (1981: 111) to material from New South Wales; however, no specimens were cited at the time.

Diospyros montana Roxb., *Pl. Coromandel* 1: 37, 48 (1795).

Australian specimens referred to this species by Bakhuizen van den Brink (1938: 265, 1941: 265–270) are *D. rugosula.* According to Kostermans (1981: 22), *D. montana* is restricted to southern India and Ceylon (Sri Lanka).

Diospyros montana f. *cordifolia* (Roxb.) Hiern, *Trans. Cambridge Philos. Soc.* 12: 222 (1873); *D. cordifolia* Roxb, *Pl. Coromandel* 1: 38, t. 50 (1796).

Australian specimens referred to this name are *Diospyros rugosula.*

Maba rufa Labill., *Sert. Austro-Caledon.* 33: t. 36 (1824).

Australian material identified with this name by Hiern (1873: 114), Bailey (1900: 963, t. XL) and Bakhuizen van den Brink (1941: 444) is referrable to *Diospyros cupulosa. Maba rufa* is a New Caledonian endemic now known as *D. labillardierei* F.White.

Diospyros whyteana (Hiern) F.White, *Bothalia* 7: 488 (1961).

In Australia this species is only known from cultivated plants (Taplin & Symon 2008: 85).

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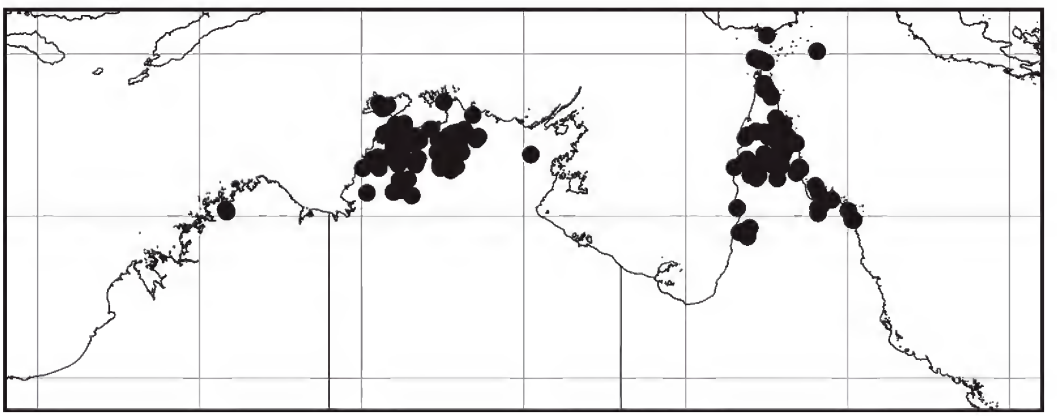
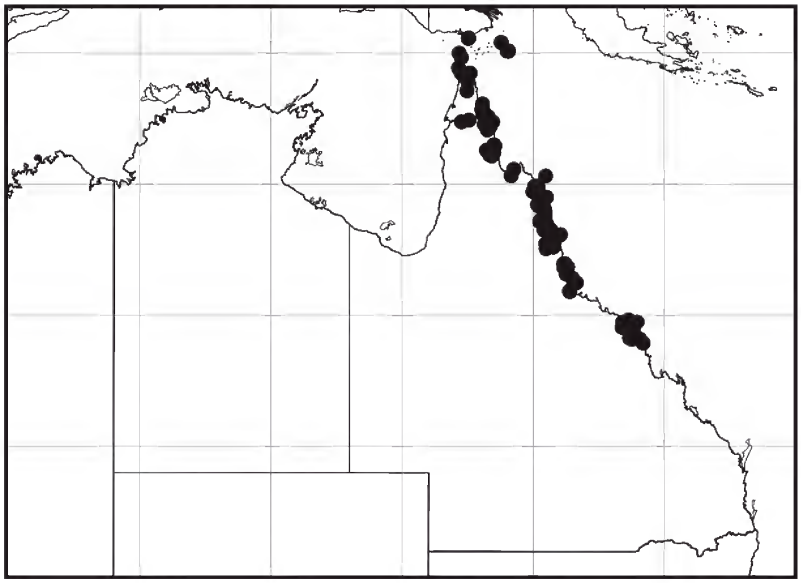
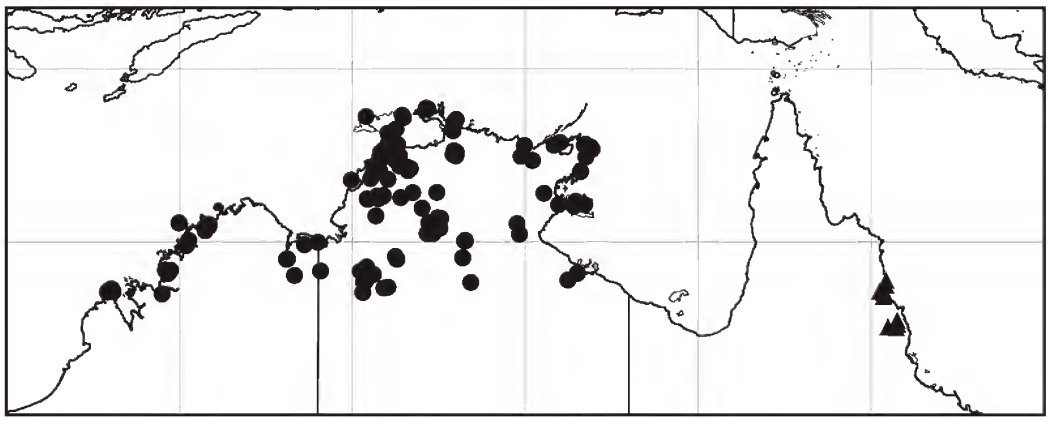


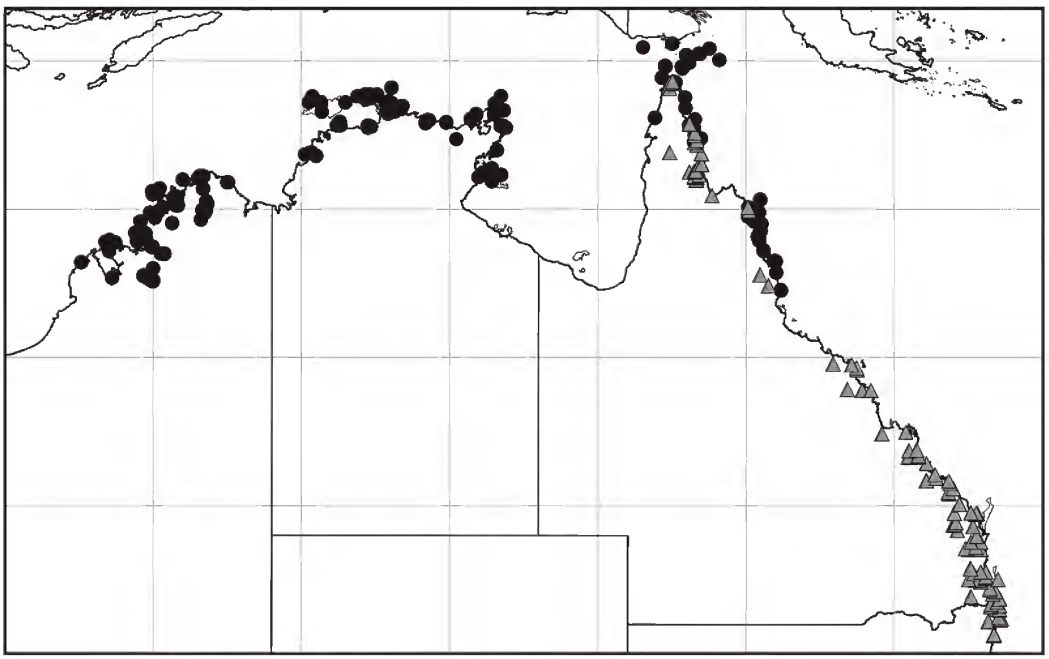
Map 1. Distribution of *Diospyros calycantha* in Australia.



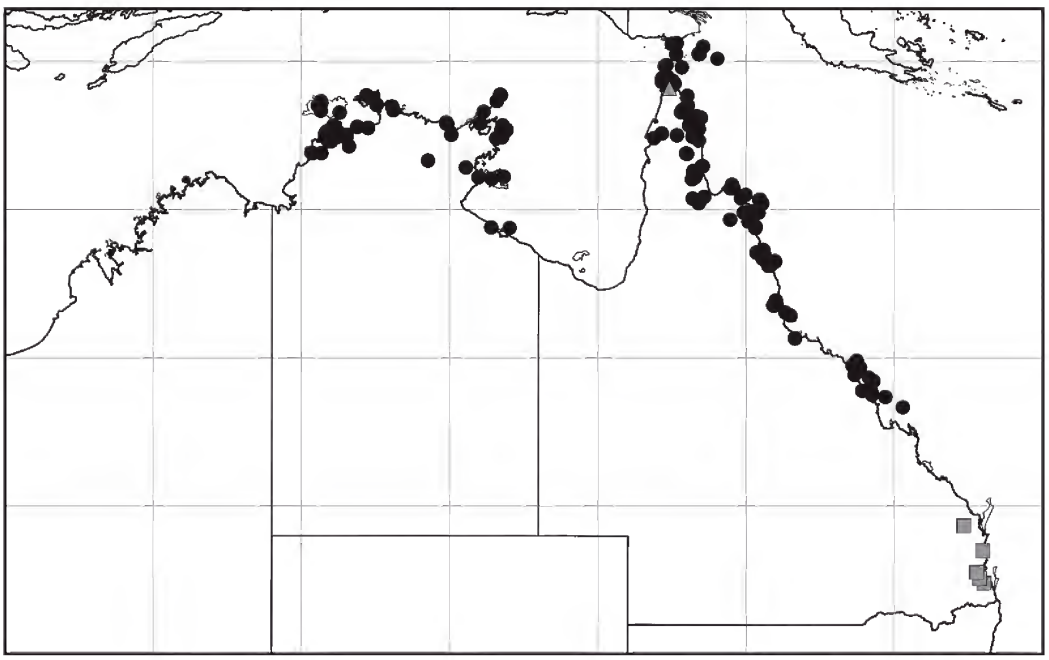
Map 2. Distribution of *Diospyros hebecarpa* in Australia.



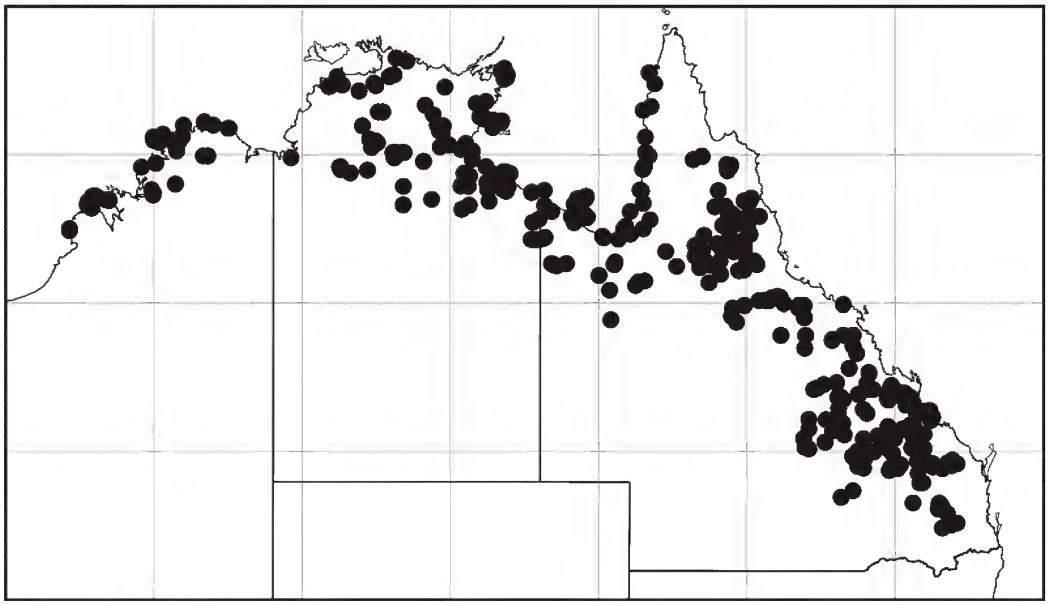
Map 3. Distribution of *Diospyros rugosula* ● and *D. uvida* ▲ in Australia.



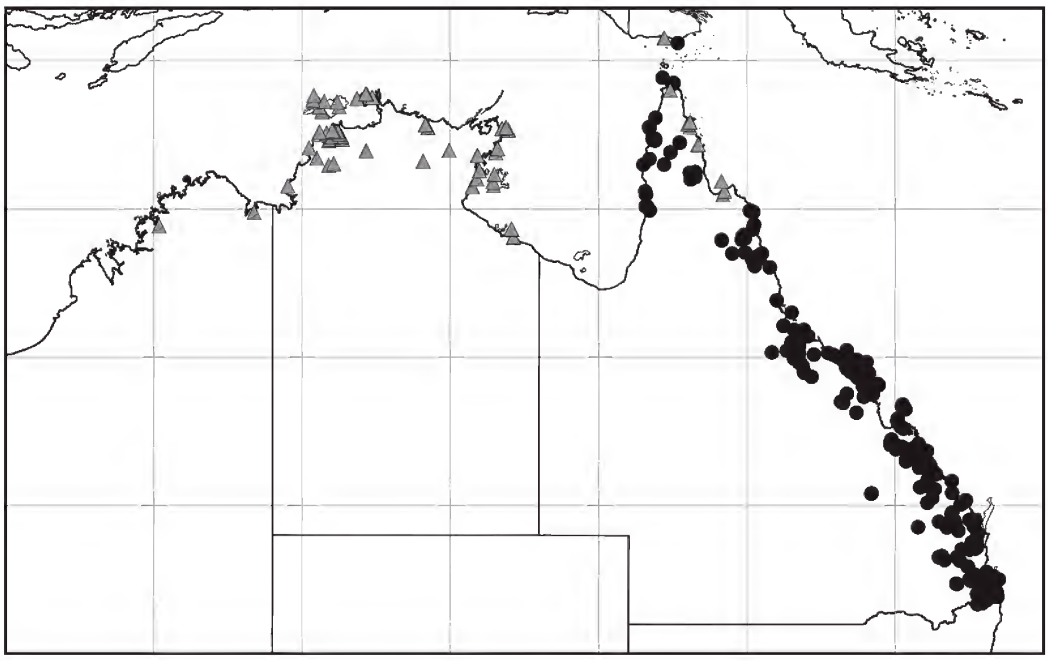
Map 4. Distribution of *Diospyros maritima* ● and *D. fasciculosa* ▲ in Australia.



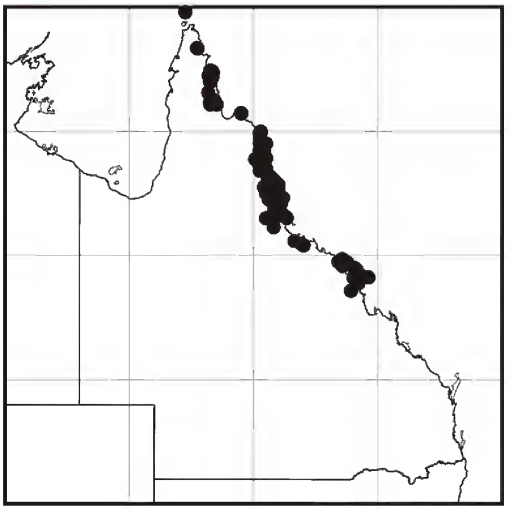
Map 5. Distribution of *Diospyros areolifolia* ▲, *D. compacta* ● and *D. kaki* ■ in Australia.



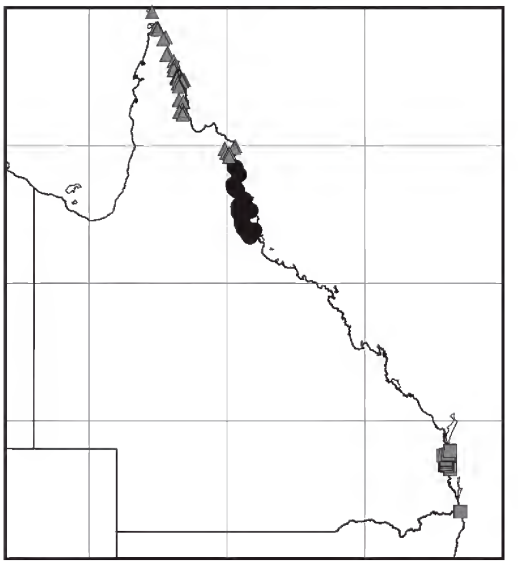
Map 6. Distribution of *Diospyros humilis* in Australia.



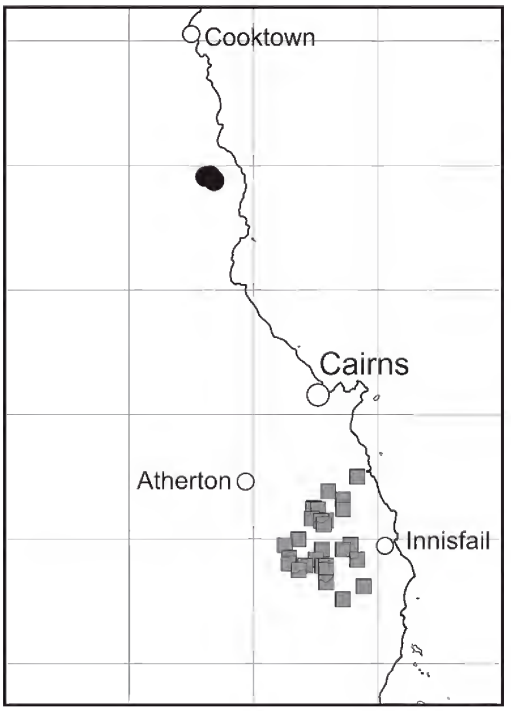
Map 7. Distribution of *Diospyros geminata* ● and *D. littorea* ▲ in Australia.



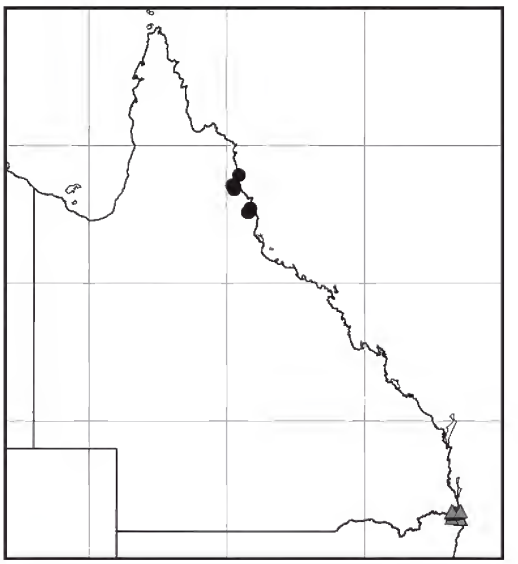
Map 8. Distribution of *Diospyros laurina* in Australia.



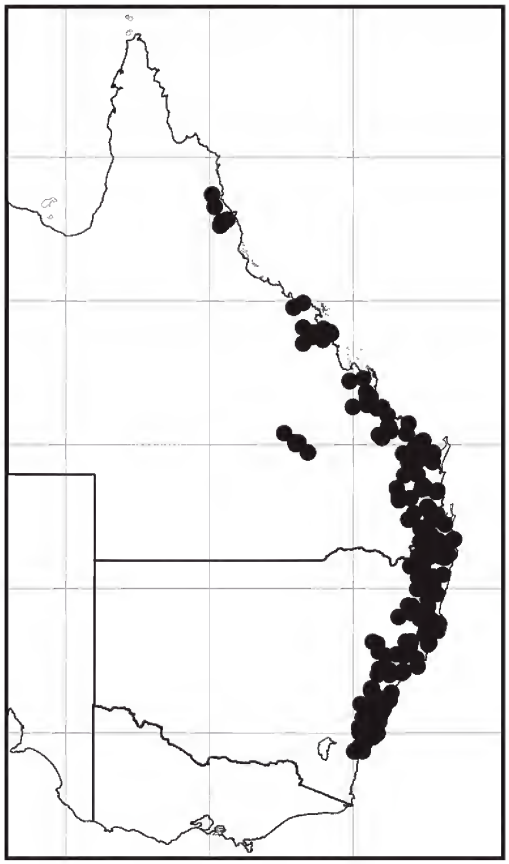
Map 9. Distribution of *Diospyros peninsularis* ▲, *D. hemicycloides* ● and *D. yandina* ■.



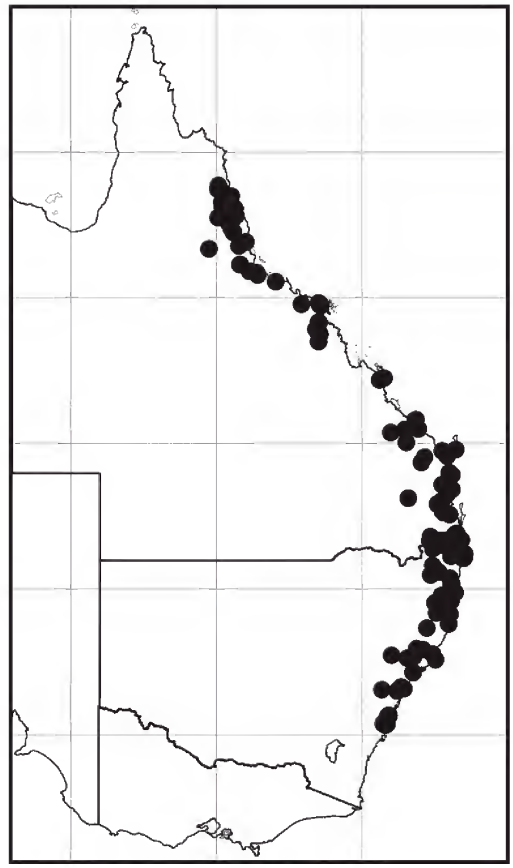
Map 10. Distribution of *Diospyros pluviatilis* ■ and *D. rheophila* ●.



Map 11. Distribution of *Diospyros granitica* ● and *D. mabacea* ▲.



Map 12. Distribution of *Diospyros australis*.



Map 13. Distribution of *Diospyros pentamera*.

Diploglottis alaticarpa W.E.Cooper (Sapindaceae), a new species from Queensland's Wet Tropics

W.E. Cooper

Summary

Cooper, W.E. (2014). *Diploglottis alaticarpa* W.E.Cooper (Sapindaceae), a new species from Queensland's Wet Tropics. ***Austrobaileya* 9(2): 198–202**. *Diploglottis alaticarpa* W.E.Cooper is described and illustrated. Notes on habitat and distribution are provided, as well as a species identification key for the genus.

Key Words: Sapindaceae, *Diploglottis*, *Diploglottis alaticarpa*, Australia flora, Queensland flora, new species, taxonomy, rainforest

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Introduction

Diploglottis Hook.f. (Sapindaceae) was noted as a genus of eight endemic species in Australia by Reynolds (1985: 33). A further two Australian endemic species were described by Reynolds (1987), *viz. D. bernieana* S.T.Reynolds and *D. obovata* S.T.Reynolds. Harden (1986) reinstated *D. australis* (G.Don) Radlk. with *D.cunninghamii* (Hook.) Hook.f. ex Benth. in synonymy. Leenhouts (1994: 520) synonymised *D. cunninghamii* (Hook.) Hook.f. ex Benth. and *D. diphyllostegia* (F.Muell.) F.M.Bailey with *D. australis* and stated there to be 11 (although this enumeration was overly incorrect) species in northeast Australia, with one of those also occurring in New Guinea and New Caledonia.

Leenhouts (1994) treatment of *Diploglottis diphyllostegia* has not been accepted and it has continued to be recognised as a distinct entity (Hyland *et al.* 2003; Cooper & Cooper 2004; Forster & Jessup 2007). Including the species newly described here, *Diploglottis* (Sapindaceae) is now a genus of 11 species, all occurring in Australia with 10 species considered endemic. *Diploglottis* in Australia is more widespread than indicated by Leenhouts (1994), occurring in rainforest and monsoon forests of eastern Australia from Cape York on northernmost Queensland to the Illawarra district in southern New South Wales.

A sterile specimen of an unsual *Diploglottis* was first collected by Rigel Jensen before 1994 and determined by the then QRS herbarium (now CNS) as *Sapindaceae* (Palmerston Rigel Jensen *s.n.*) as evidenced in Cooper (1994: 312); however, the specimen appears to be lost. Since 1994, subsequent collections of this plant have been usually included within *D. bracteata* Leenh. Additional fertile specimens have conclusively shown that the species described below as *D. alaticarpa* W.E.Cooper is quite distinct from that species in leaf and fruiting features. From herbarium records and field observations, *D. alaticarpa* and *D. bracteata* do not occur together and are therefore allopatric.

Diploglottis was considered by Acevedo-Rodríguez *et al.* (2011) to be falsely polygamous and Gross (2005) described *D. smithii* S.T.Reynolds as monoecious. Whereas, vouchers from *D. alaticarpa* with male flowers (*Cooper 2229*) and with bisexual flowers (*Cooper 2230*), both collected from the same tree but on different dates, confirm the species to be polygamo-dioecious.

Based on *Diploglottis* species known at the time, Leenhouts (1994) characterised the genus as having fruit that are not winged;

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however, the new species described herein has distinctly winged sutures, a newly recognised trait for *Diploglottis*.

Materials and methods

The study is based upon the examination of herbarium material from CNS and BRI, as well as field observations. All specimens cited have been seen by the author.

Measurements of the floral parts and fruits are based on material preserved in 70% ethanol as well as fresh material from the field.

Taxonomy

Diploglottis alaticarpa W.E.Cooper **sp. nov.** Similar to *D. bracteata* Leenh. but differs in the new leaves (silvery-pink versus silvery-green), rachis (sericeous becoming glabrescent versus persistently sericeous), leaflet upperside (shiny versus dull), primary vein on leaflet upperside (slightly raised versus flat or slightly raised within a distinctly deep and narrow groove), fruit (winged versus not winged, sparsely hairy versus puberulent, opening widely and becoming campanulate to allow seeds to fall versus opening slightly and not changing shape (never campanulate) with valves separating and dropping to allow seeds to fall or whole fruits fall and dehisce on the ground). **Typus:** Queensland. Cook District: Southern side of Palmerston Highway near Mamu Boardwalk, Wooroonooran National Park [west of Innisfail], 19 December 2013, *W.Cooper 2232* & *R.Jensen* (holo: CNS [3 sheets + spirit]; iso: BRI, CANB, K, L, MO *distribuendi*).

Sapindaceae (Palmerston Rigel Jensen *s.n.*); Cooper & Cooper (1994: 312).

Tree to 22 m, monoecious, dbh to 40 cm; trunk not fluted, bark lacking distinctive features; branchlets shallowly ribbed, minutely lenticellate, glabrous; new growth silvery-pink and sericeous. **Leaves** compound, alternate; rachis + petiole 12–41 cm long, sericeous but soon glabrescent, flattened along upperside, ribbed, minutely lenticellate, pulvinus 7–12 mm long. **Leaflets** subopposite to alternate, coriaceous, 9–19; petiolules 7–25 mm long, grooved on upperside, pulvinulus 5–12 mm long, glabrescent; lamina oblong, oblong-obovate or oblong-elliptical, 44–185 mm long, 18–63 mm wide; base cuneate, sometimes asymmetrical; apex emarginate; margin entire; upperside glabrous or with sparse minute hairs on secondary veins; underside glabrescent with sparse appressed minute hairs; venation camptodromous; primary vein slightly raised; secondary veins 8–15 pairs, slightly raised on upperside and distinctly raised on underside; tertiary venation reticulate. **Inflorescence** an axillary or pseudo-terminal panicle up to 240 mm long, sericeous; rachis ribbed, pulvinate; cymules 4-flowered; bracts caducous, ovate, base truncate, apex acute, 12–25 mm long, 3–7 mm wide, both sides sericeous. **Flowers** actinomorphic, unisexual (staminate) or apparently bisexual, diameter 2.3–5.3 mm, buds broadly ovoid; pedicels 1.5–2 mm long, terete; calyx shortly cupular, 5 lobed, lobes *c.* 2 mm long and wide, both sides sericeous; petals 5, broadly orbicular or obovate, 1.3–2.5 mm long, 1.5–2.5 mm wide, outside sparsely pilose proximally, pilose inside, margin ciliate; scale divided to base, crested, pilose; disk annular, thick, not interrupted, glabrous; stamens 7 or 8, filaments to 2 mm long, pilose, hairs proximally denser; anthers oblong, bilocular, *c.* 1 mm long, basifixed, dehiscing laterally, glabrous; pistillode sericeous, 3-celled; ovary sericeous, *c.* 2 mm long, 3-locular; ovules 1 per locule; style sparsely hairy. **Fruiting pedicel** 5–8 mm long; **fruit** a 3-(rarely 4-) locular capsule, triangular-oblate (unless 1 or 2 ovules are aborted then asymmetricaly oblate or globular), 26–33 mm long, 23.5–44 mm wide, yellowish-green and mostly blushed with pink proximally, sparsely and minutely hairy; sutures winged in basal half, wings 2.5–4 mm wide; walls leathery, orange and sericeous inside, opening widely and becoming campanulate to allow shedding of seeds; seeds 1–3, lenticular, 14–26 mm long, 16–22 mm wide, 9–14.5 mm thick, testa dark brown; aril 2-lobed, orange-red, completely or almost completely covering seed, margin thin. **Fig. 1.**

***Additional specimens examined*: Queensland.** Cook District: Pullom Road, Palmerston, Sep 2013, *Cooper 2228 & Cooper* (CNS); *loc. cit.*, Oct 2013, *Cooper 2229* (CNS); *loc. cit.*, Nov 2013, *Cooper 2230* (CNS); Pullom

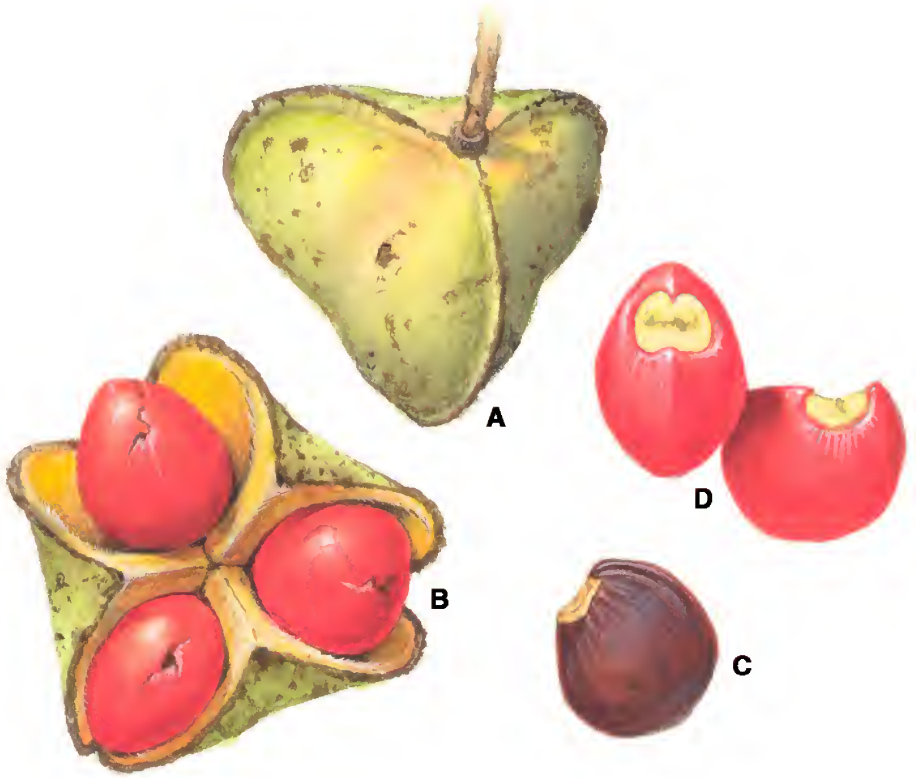

Fig. 1. ***Diploglottis alaticarpa*** fruit A. Indehisced fruit viewed from base, showing winged sutures. B. Dehisced fruit from apex, showing sericeous inner valves and arillate seeds. C. Seed with aril removed. D. Seeds with arils intact showing pale coloured attachment scar. All natural size. Del. W.T.Cooper

Road, 17 km WNW of South Johnstone, Dec 2003, *Forster PIF29795 & Jensen* (BRI); Wooroonooran NP Palmerston Section, Dec 1998, *Jensen 947* (BRI); Near Bora Creek, Johnstone River, Oct 1995, *Jensen 432* (CNS); Crawfords Lookout, Palmerston NP, Dec 2013, *Cooper 2233 & Jensen* (CNS); NPR 904, Palmerston, near Crawfords Lookout, Jan 1997, *Jensen 812* (CNS).

***Distribution and habitat*:** *Diploglottis alaticarpa* is endemic to the Wet Tropics bioregion in north-east Queensland, where it is currently known to occur mostly within Wooroonooran National Park in the Palmerston section, between the Johnstone River and the South Johnstone River west of Innisfail, altitude 100–362 m (**Map 1**).

Diploglottis alticarpa grows as an understory tree in complex mesophyll vine forest on basalt soil. It commonly co-occurs with *Aglaia ferruginea* C.T.White & W.D.Francis, *Argyrodendron trifoliolatum* F.Muell., *Cardwellia sublimis* F.Muell., *Eupomatia laurina* R.Br., *Flindersia brayleyana* F.Muell., *Myristica globosa* subsp. *muelleri* (Warb.) W.J.de Wilde, *Neolitsea dealbata* (R.Br.) Merr., *Rhysotoechia robertsonii* (F.Muell.) Radlk., *Synima macrophylla* S.T.Reynolds and *Syzygium gustavioides* (F.M.Bailey) B.Hyland.

***Phenology*:** Flowers have been recorded in October and November: fruits have been recorded in December and January.

***Affinities*:** *Diploglottis alaticarpa* appears to be most similar to *D. bracteata*. The leaves, flowers, arils and seeds are similar but the two species differ most remarkably by the

colour of new leaf growth (silvery-pink versus silvery-green), primary vein (virtually flush with leaf blade versus slightly raised or flush in a deep groove) and fruit sutures (winged versus not winged).

***Etymology*:** The specific epithet comes from the Latin *alatus* (winged), *carpus* (fruit) referring to the winged fruit, an unusual trait for *Diploglottis*.

Identification key to *Diploglottis* species

1 Fruit sutures outwardly ribbed or winged **2**
1. Fruit sutures smooth or depressed **3**

2 Fruit green, sparsely hairy, sutures distinctly winged; leaflets flat, glabrous or with sparse minute pale hairs . . . . . **D. alaticarpa**
2. Fruit yellow or orange, densely rusty hairy, sutures ribbed not truly winged; leaflets bullate and rusty hairy . . . . . **D. bernieana**

3 Fruit glabrous or sparsely hairy **4**
3. Fruit velvety or densely hairy **6**

4 Aril orange; young growth, peduncles and leaf axes villous with deep red hairs; leaflets 5–10 pairs . . . . . **D. pedleyi**
4. Aril red (with the exception of a very rare occurrence of orange); indumentum of pale hairs; leaflets 2–4 pairs **5**

5 Fruit valves thick; petiolules 10–35 mm long; inflorescence 10–25 mm long; occurs north of Innisfail NE Qld . . . . . **D. harpulliodes**
5. Fruit valves thin, aril rarely orange; petiolules 2–5 mm long; inflorescence 120–160 mm long; occurs in SE Qld and NE NSW . . . . . **D. campbellii**

6 Leaflets distinctly bullate **7**
6. Leaflets flat, secondary veins may be depressed but not truly bullate **9**

7 Indumentum of pale hairs . . . . . **D. smithii**
7. Indumentum of rusty or dark brown hairs **8**

8 Sparsely branched or mostly an unbranched tree to 6 m; new growth pink; occurs north from Cooktown NE Qld . . . . . **D. macrantha**
8. Tree to 35 m; new growth green; occurs south from Mt Walsh NP SE Qld and NE NSW . . . . . **D. australis**

9 Indumentum silvery; primary vein slightly raised or flush in a deep groove . **D. bracteata**
9. Indumentum rusty; primary vein not deep with a groove **10**

10 Leaflet apices shortly acuminate; occurs north from Eungella, central eastern Qld . . . . . **D. diphyllostegia**
10. Leaflet apices obtuse or truncate; occurs from Sarina to Proserpine area, central eastern Qld . . . . . **D. obovata**

Acknowledgements

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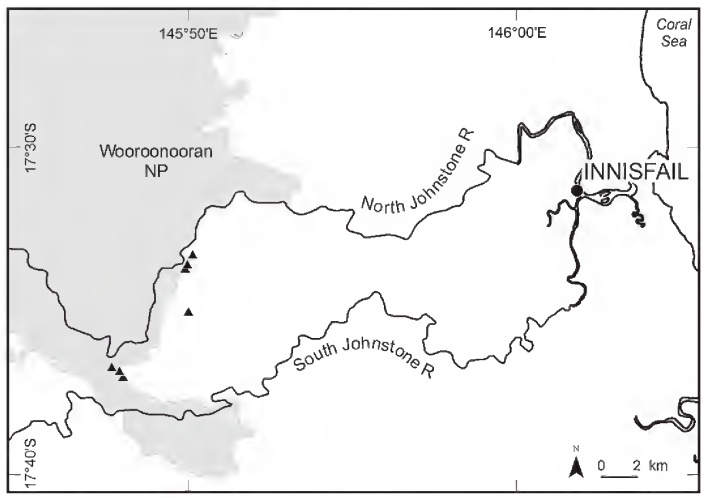

Map 1. Distribution of *Diploglottis alaticarpa* in northeast Queensland. Shaded area on map indicates Wooroonooran National Park.

Ptilotus senarius A.R.Bean (Amaranthaceae), a new species from northern Queensland

A.R. Bean

Summary

Bean, A.R. (2014). *Ptilotus senarius* A.R.Bean (Amaranthaceae), a new species from northern Queensland. ***Austrobaileya* 9(2): 203–206**. The new species *Ptilotus senarius* A.R.Bean, recorded only between Georgetown and Croydon, is described, illustrated, and differentiated from similar taxa. A conservation status of Presumed Extinct is proposed.

Key Words: Amaranthaceae, *Ptilotus*, *Ptilotus senarius*, Australia flora, Queensland flora, new species, taxonomy, presumed extinct, conservation status

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Introduction

Ptilotus is a genus of about 100 species, of which 31 occur in the four eastern states of Australia (Bean 2008). Within the family Amaranthaceae, it is characterised by the alternate leaves, the ovoid to cylindrical inflorescences, single-seeded fruits and the flowers with five tepals bearing hairs at least towards the base.

In late 2008, the present author distinguished the species here described from herbarium specimens at BRI. They had been identified by G. Benl as *Ptilotus exaltatus* var. *semilanatus* (now known as *P. nobilis* subsp. *semilanatus* (Lindl.) A.R.Bean).

The new species does appear to have some affinity to *Ptilotus nobilis* subsp. *semilanatus*, although it is geographically disjunct from that taxon. It has similar vegetative characteristics to *P. fusiformis* (R.Br.) Poir., but is very different in floral morphology. The new species is diagnosed against these two taxa.

Despite a relatively small target search area, no one has been able to relocate the species in the field and it is presumed **Extinct** at present.

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Materials and methods

All herbarium specimens of *Ptilotus* held at BRI and MEL have been examined. Measurements were made from dried material.

Taxonomy

Ptilotus senarius A.R.Bean **sp. nov.** *P. nobili* subsp. *semilanato* affinis sed foliis angustioribus, caulibus pilis stellatis praeditis, ovario glabro et inflorescentiis paucifloris differens. **Typus:** Queensland. Cook District: Riverview, Gilbert River, 10 May 1967, *S.J. Dansie 3873* (holo: BRI; iso: CANB, *distribuendi*; CNS, image seen).

Ptilotus sp. (Gilbert River L.J. Brass 430); Bostock & Holland (2010: 9).

Slender branched shrub 30–60 cm high, with a woody base. Stems terete, densely stellate hairy on new growing tips, but only sparsely hairy elsewhere. Hairs stellate or pseudo-stellate (with the radial arms perhaps not all arising from the same point), 0.15–0.3 mm diameter, broader than high, white, rays 3–12, no central ray discernable. Leaves alternate, linear, 7–31 mm long, 0.6–1.5 mm wide, apex acute, base attenuate, petiole absent, glabrous or with sparse stellate hairs. Inflorescence terminal, 1–6(–8)-flowered, with flowers disposed at various angles to the stems and rachis; bracts persistent on rachis,

broadly ovate, cymbiform, 2.7–3.2 mm long, apex acute, outer surface densely covered by stellate and verticillate hairs except laterally; bracteoles caducous, ovate, cymbiform, 3.8–4.6 mm long, apex aristate, outer surface densely covered by verticillate and stellate hairs; perianth 15–19 mm long at anthesis; tepals 5, fresh colour unknown, grey when dried, linear, straight, apex acute, dorsal surface densely covered by antrorse verticillate hairs 0.4–0.6 mm long, and antrorse septate hairs 2.3–6 mm long; distal 1–1.5 mm of tepals without any hairs attached. Two outer tepals slightly longer than three inner tepals; outer tepals glabrous on ventral surface; inner tepals with dense woolly hairs on proximal one-third of ventral surface, otherwise glabrous. Fertile stamens 3, 7–10 mm long; filaments slender, brown; anthers *c.* 1.7 mm long, caducous. Ovary glabrous throughout. Style 8–12 mm long, mostly straight, but sinuously curved at about halfway along its length, eccentrically inserted on ovary; stigma expanded. **Figs. 1, 2.**

***Additional specimen examined*: Queensland.** Cook District: Gilbert River, Jun 1925, *Brass 430* (BRI).

***Distribution and habitat*:** *Ptilotus senarius* has been collected only near the Gilbert River, between Georgetown and Croydon in northern Queensland. The habitat given for the two collections is somewhat contradictory: one label with "in tea-tree forest" i.e. dominated by *Melaleuca* spp., most of which favour low-lying areas; while the other with "on grassy hills".

***Phenology*:** Flowers are recorded for May and June.

***Affinities*:** *Ptilotus senarius* is perhaps closely related to *P. nobilis* subsp. *semilanatus*, as they both have narrow leaves, tepals of about the same length, and similar tepal indumentum. However, *P. senarius* is readily distinguished by the leaves less than 1.5 mm wide and without sinuate margins (leaves 2–10 mm wide and with sinuate margins for *P. nobilis* subsp. *semilanatus*), the glabrous ovary (hairy for *P. nobilis* subsp. *semilanatus*), inflorescences 1–6(–8)-flowered (30–100-flowered for *P. nobilis* subsp. *semilanatus*), flowers projecting at various angles from the rachis (flowers perpendicular to rachis and stem for *P. nobilis* subsp. *semilanatus*) and the stems with stellate hairs (hairs absent or verticillate for *P. nobilis* subsp. *semilanatus*).

Ptilotus senarius is similar to *P. fusiformis* in height and form of the plant, and the similarly linear leaves. The stems and leaves of both species appear to the naked eye to be glabrous. However, *P. senarius* is readily distinguished by its stems with small stellate hairs (glabrous for *P. fusiformis*), inflorescences 1–6(–8)-flowered (12–27-flowered for *P. fusiformis*), perianth 15–19 mm long (8–13 mm long for *P. fusiformis*), and the tepals with both verticillate and septate hairs on the dorsal surface (with septate hairs only for *P. fusiformis*).

***Conservation status*:** It is considered that the distribution of the species is relatively well circumscribed, and nearly 50 years have elapsed since the most recent known sighting.

A major road passes through the Gilbert River area, giving ready access to botanists, and the May–June period (when the previous collections were made) is a popular time for travel in this region. Hence one expects that further serendipitous collections would have been made since 1967, if the species were present.

Since the recognition of the species in late 2008, several active searches have been made in the Gilbert River area, mainly around May and June, but also at other times of the year. During these years, the area has been subject to a widely varying regime of rainfall and temperature patterns, including periods suitable for germination of herb and shrub species. Much of the area is without major weed infestation (except in riparian areas), but cattle grazing has been a continuous land use for a century or more. *Ptilotus* species are known to be sensitive to grazing pressure (Letnic 2004; Fensham *et al.* 2010).

Taking into consideration the grazing threat, the well circumscribed distribution, the time elapsed since the most recent collection, and the inability to locate further plants, a category of **Presumed Extinct** (X) is proposed (IUCN 2001).

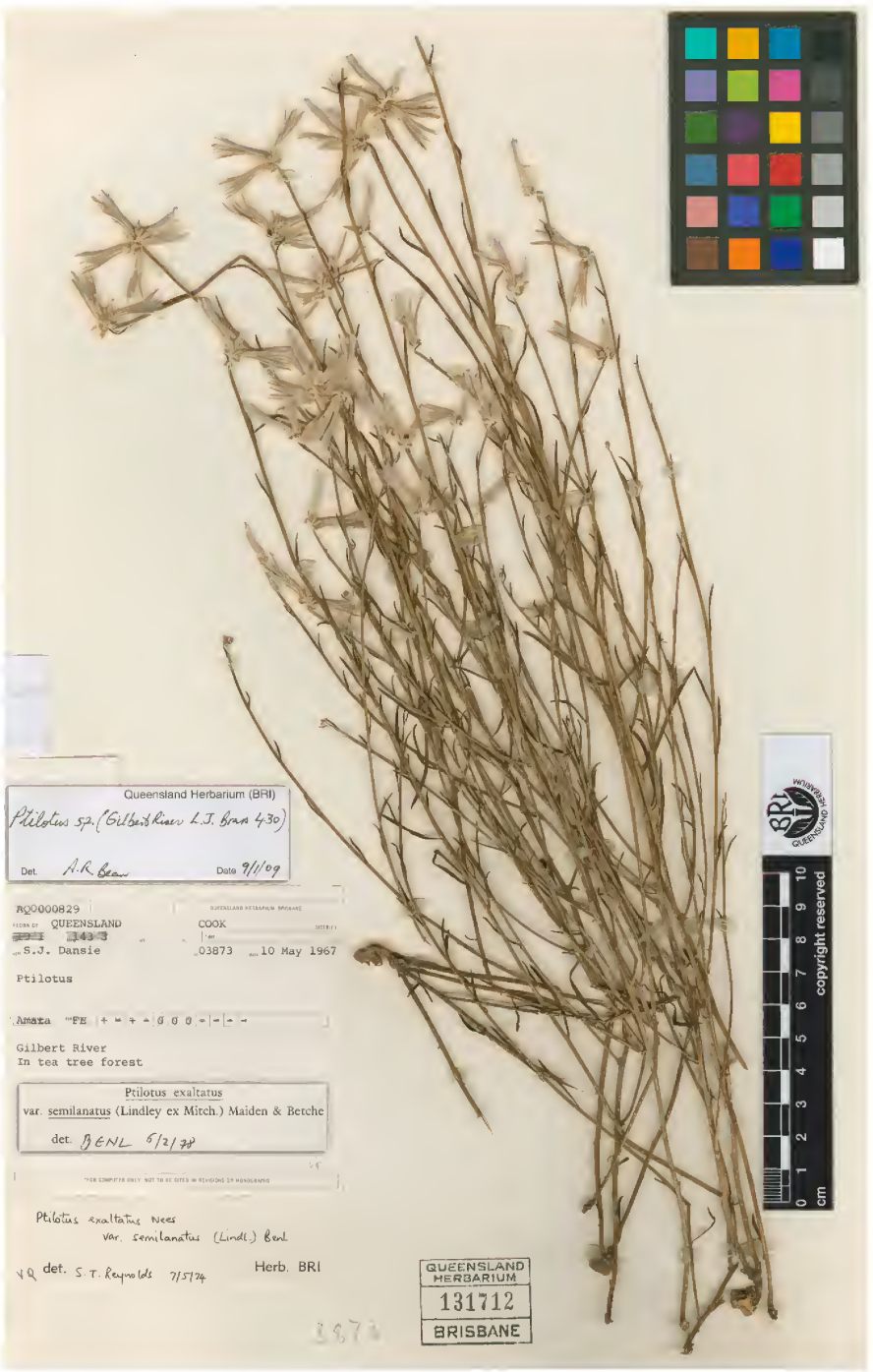

Fig. 1. Holotype of ***Ptilotus senarius*** (*Dansie 3873*) (BRI).

Fig. 2. Inflorescences of *Ptilotus senarius* (*Dansie 3873*) (BRI).

***Note*:** The isotype at CNS bears the locality "Riverview, Gilbert River", whereas the holotype specimen at BRI merely states "Gilbert River".

***Etymology*:** From the Latin *senarius* meaning 'consisting of six'. This refers to the few flowers making up each inflorescence, usually no more than six.

Acknowledgements

I am grateful to Keith McDonald for his several dogged attempts to relocate this species in the field. I thank the Director of MEL for access to their collections, and Frank Zich for sending images of the Dansie specimen at CNS. Peter Bostock kindly translated the diagnosis into Latin. Will Smith produced the specimen scans.

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Diversity on a tropical sky island: two new species of *Plectranthus* L.Hér. (Lamiaceae) from the Hann Tableland, north-east Queensland

Paul I. Forster

Summary

Forster, P.I. (2014). Diversity on a tropical sky island: two new species of *Plectranthus* L.Hér. (Lamiaceae) from the Hann Tableland, north-east Queensland. ***Austrobaileya* 9(2): 207–215.** A remarkable array of *Plectranthus* populations occurs on boulder and pavement fields on the geographically isolated Hann Tableland west of Mareeba in north-east Queensland. Seven species are present, namely *P. bellus* P.I.Forst., *P. bipartitus* P.I.Forst. sp. nov., *P. congestus* S.T.Blake, *P. foetidus* Benth., *P. mirus* S.T.Blake, *P. spectabilis* S.T.Blake and *P. splendens* P.I.Forst. sp. nov. The newly described species are illustrated and a distribution map is presented to all the species of *Plectranthus* on the Hann Tableland.

Key Words: Lamiaceae, *Plectranthus*, *Plectranthus bipartitus*, *Plectranthus splendens*, Australia flora, Queensland flora, Hann Tableland, new species, taxonomy, sky island, conservation status

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Introduction

The genus *Plectranthus* L.Hér. is diverse in Australia, with over 40 species described so far. Most species are boulder or pavement specialists where they grow in shallow, skeletal soils. These habitats can be variable within themselves, with a matrix of 'micro environments' and the plants that occur often do so in narrow bands or patches determined by soil depth and moisture. These physical and edaphic factors, compounded by geographic isolation and the breeding biology of these herbs or subshrubs are thought to have driven speciation in eastern Australia (Forster 2011) resulting in a mix of widespread species and narrowly distributed endemics.

The Hann Tableland is a massive, geographically isolated granite pluton nearly 30 × 6 km in area and is located west of Mareeba in north-east Queensland. The granites of the tableland are part of the Kennedy Province Granites, specifically the Whypalla Supersuite and have been dated as early Permian (275 ± 15 Ma) in age (Champion & Bultitude 2013). The topography of the Hann Tableland ranges from *c.* 350 m at its base with the surrounding foothills to high points of 950–1000 m. From north to south, the tableland runs roughly south-southwest with gentle to very steep slopes. Much of the tableland is covered in woodland; however, some gully systems and high points have closed forests (rainforests). Interspersed throughout the woodland ecosystems are large areas of outcropping rock characterised by extensive areas of pavement and small to massive boulders or outcrops. These latter habitats have shallow to no soil cover and usually have vegetation that is markedly seasonal, comprising a mixture of grasses, sedges and other herbs. This 'ephemeral flush' vegetation (Porembski *et al.* 2000) has relatively few perennial species; these are generally woody with either deep or lateral, water seeking roots, are resurrection plants (e.g. *Borya septentrionalis* F.Muell., *Cheilanthes* spp.), or in the case of *Plectranthus* species have fleshy to succulent rootstocks and foliage.

The Hann Tableland pluton is a 'sky island' (Heald 1951; Watling & Donnelly 2006) as it is surrounded by other geology (metasediments) at lower altitudes and is geographically disjunct from other granite massives of the

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Whypalla Supersuite (e.g. Bakers Blue, Mount Windsor Tableland/Daintree National Park). The upland vegetation and flora on the Hann Tableland is in part refugial in composition (particularly the rainforest communities, to a lesser extent the woodland communities); however, the plant communities on skeletal soils exhibit a low level of localised endemism by the presence of species such as *Stylidium elachophyllum* A.R.Bean & M.T.Mathieson and the two species described here. The presence of these plant species, together with a number of insects (Bouchard & Brooks 2004) reinforces the hypothesis that the Hann Tableland comprises an area of biodiversity endemism. The sharing of some species (e.g. *Plectranthus bellus* P.I.Forst., *Pterostylis caligna* M.T.Mathieson) from these communities with similar habitats elsewhere (e.g. Mount Windsor Tableland/Daintree National Park) indicates past, relatively recent dispersal events rather than vicariance. This hypothesis is based on the reproductive biology of the plants listed, reiterating my previous comments (Forster 2011: 387) and the irregular outcropping petrogenesis of the granites and their subsequent erosion over the past 270 Ma (Champion & Bultitude 2013). This recent dispersal has also undoubtedly been responsible for the various populations of *Plectranthus* known from the Hann Tableland, especially those known from one or few populations.

Extensive fieldwork on the Hann Tableland has revealed a large number of *Plectranthus* populations (**Map 1**). Generally a single or two species occur at any one site; however, where two species are present, there is often subtle edaphic separation of plants based on soil depth and seasonal water supply. The co-occurring species are markedly different in morphology and appear to be reproductively isolated as hybrids have not been seen. This reproductive isolation is apparently maintained by genetic differences or in some instances by phenology.

Seven species of *Plectranthus* have now been recorded from the Hann Tableland. Four of these are relatively widespread in north-east Queensland, *viz. P. congestus* R.Br., *P. foetidus* Benth., *P. mirus* S.T.Blake, *P. spectabilis* S.T.Blake; one has a more restricted distribution between the Mount Windsor Tableland and Daintree National Park, *viz. P. bellus*, and two are newly described in this paper.

Materials and methods

Fieldwork on the Hann Tableland was undertaken between 2006 and 2013 with the use of helicopters to explore isolated or remote areas of suitable habitat in 2010 and 2013; however, due to the rugged vastness of the area further exploration is still warranted. Specimens were prepared in the field or from material cultivated in a garden in Brisbane. Six or more seedlings were collected from populations selected for further study using cultivated plants. Descriptions and illustrations were prepared from cultivated plants.

Taxonomy

Plectranthus bipartitus P.I.Forst. **sp. nov.** Distinct within Australian *Plectranthus* by the bipartite form of the individual cymes of the verticillasters and the extensive two-tiered indumentum, particularly glandular trichomes and 'micro' glandular papillae. **Typus:** Queensland. Cook District: Hann Tableland National Park, southern end; west of Mareeba, 8 April 2013, *P.I. Forster PIF39595* (holo: BRI [2 sheets + spirit]; iso: CNS, K, MEL distribuendi).

Erect herb or subshrub to 100 cm high; foliage with very strong sweetly aromatic scent when crushed, somewhat clammy; non-glandular and glandular trichomes uncoloured, sessile glands absent. Roots thickened-tuberous to fibrous. Stems square, erect to rarely straggling, fleshy-succulent, easily snapped without obvious stringy fibres, the lower parts up to 9 mm diameter, pale green, upper parts with persistent indumentum, non-glandular trichomes sparse, divaricate to weakly retrorse, 6–8-celled up to 0.5 mm long, glandular trichomes dense, variable length to 0.3 mm. Leaves discolorous, petiolate; petioles 10–21 × 2–3.5 mm, channelled on top, non-glandular trichomes sparse, divaricate, 6–8-celled up to 1 mm long,

glandular trichomes dense, variable length to 0.3 mm; laminae ovate to broadly ovate, firm fleshy, weakly keeled, 35–110 × 27–105 mm, crenate with 8–10 teeth up to 12 mm long on each margin, of similar length along margin, secondary teeth usually present; tip acute; base rounded to truncate; upper surface mid-green, veins deeply impressed, non-glandular trichomes sparse, divaricate, 6–8-celled up to 1 mm long, glandular trichomes sparse, variable length to 0.3 mm long; lower surface pale green, somewhat scabrid, veins strongly raised, non-glandular trichomes sparse (denser on veins), divaricate, 6–8-celled up to 1 mm long, glandular trichomes sparse to moderately dense, variable length to 0.3 mm long. Inflorescence up to 300 mm long, usually single with no side branches, pedunculate for 20–30 mm, often with very small subtending leaves; axis square in cross-section, non-glandular trichomes sparse, divaricate, 6–10-celled up to 1.2 mm long and with numerous 'micro' trichomes, glandular trichomes dense, up to 0.3 mm long and with dense 'micro' papillae; bracts broadly ovate to obovate, 1.7–2 × 1–1.8 mm, ecomose, non-glandular trichomes sparse, divaricate, 6–8-celled up to 0.5 mm long, glandular trichomes dense, up to 0.3 mm long and with dense 'micro' papillae; verticillasters 12–20-flowered, 5–6 mm apart; cymes very shortly pedunculate for 0.5–1 mm, bipartite; pedicels 2–2.8 × *c.* 0.3 mm, non-glandular trichomes scattered or occasional, divaricate, 4–8-celled up to 0.6 mm long, glandular trichomes sparse to dense, up to 0.3 mm long and with dense 'micro' papillae. Flower calyces 2–2.5 mm long, non-glandular trichomes scattered, divaricate, 6–8-celled up to 0.8 mm long and with 'micro' papillae, glandular trichomes sparse and with 'micro' papillae. Corolla 7–8 mm long, lilac (mauve), 'micro' papillae absent; tube 4.8–5 mm long, curved at 70–90° *c.* 2 mm from the base, not curved upwards, ± glabrous or with an occasional non-glandular trichome 2–4-celled and up to 0.3 mm long; upper lobes orbicular-ovate, erect or slightly reflexed, *c.* 1.5 × 1.5 mm, non-glandular trichomes sparse, divaricate, 4–6-celled up to 0.5 mm long, glandular trichomes usually absent; lateral lobes oblong, *c.* 1 × 0.7–0.8 mm, glabrous; lower lobe broadly ovate, 4–4.5 × 3.5–4 mm, non-glandular trichomes scattered, divaricate, 4–6-celled up to 0.5 mm long, glandular trichomes scattered; filaments filiform, 7–8 × *c.* 0.2 mm, lilac, fused for 2–4 mm from the base; anthers 0.3–0.4 × 0.25–0.35 mm; style filiform, 9–10 × *c.* 0.2 mm, lilac, bifid for *c.* 0.1 mm. Fruit calyces 3.5–4 mm long; upper lobe oblong-ovate, 1.2–1.5 × *c.* 9 mm; lateral lobes lanceolate-falcate to lanceolate, 1.5–2 × *c.* 0.6 mm; lower lobes lanceolate-falcate, 2–2.1 × 0.5–0.7 mm. Nutlets *n.v.* **Fig. 1.**

***Additional specimens examined*: Queensland.** Cook District: Hann Tableland, May 1997, *Jago 4344 & Jensen* (BRI); Hann Tableland NP, northern end of tableland; west of Mareeba, Apr 2013, *Forster PIF39690* (BRI, CNS, MEL).

Distribution and habitat: *Plectranthus bipartitus* is currently known from two populations from northern and southern ends of the Hann Tableland **(Map 1)**. In both instances, plants occur in skeletal soils on steep granite slabs at altitudes between 570 and 815 m in association with seasonal ephemeral flush vegetation, predominantly of grasses, sedges and annual herbs.

***Notes*:** *Plectranthus bipartitus* was first collected by Bob Jago and Rigel Jensen in 1997. It is a large and distinctive plant and likely to be noticed by botanical collectors due to its presence on exposed areas of pavement.

Plectranthus bipartitus has a number of distinct features that are not present in other Australian species from this genus. There is a passing superficial similarity to *P. diversus* S.T.Blake; however, that species has a combination of leaf morphology and indumentum (especially the widespread occurrence of sessile orange glands), combined with inflorescence structure that is not present in *P. bipartitus*. The bipartite nature of the cymes in *P. bipartitus* is unique in Australian *Plectranthus*. The widespread occurrence of two-tiered indumentum layers (**Fig 1B**), particularly the abundant glandular 'micro' papillae on the foliage and inflorescence of *P. bipartitus* is also diagnostic. The occurrence of 'micro' papillae on the foliage of other Australian *Plectranthus* is relatively

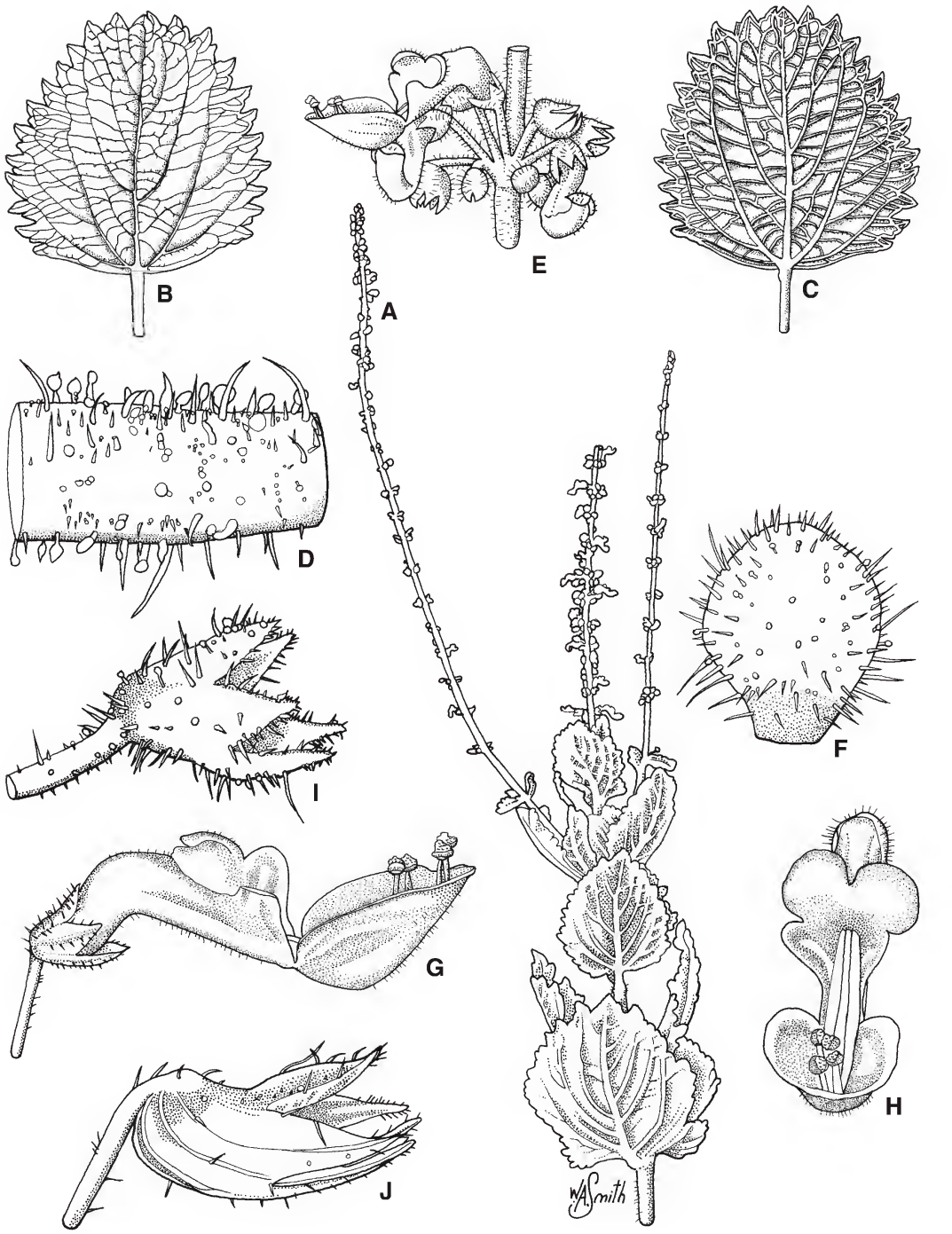

Fig. 1. ***Plectranthus bipartitus***. A. habit of flowering stem ×0.4. B. adaxial leaf surface ×0.6. C. abaxial leaf surface ×0.6. D. indumentum on stem indicating two-tiered nature ×24. E. bipartite cyme of verticillaster ×3. F. floral bract ×12. G. lateral view of flower ×6. H. face view of flower ×6. I. lateral view of flower pedicel and calyx ×12. J. lateral view of fruiting pedicel and calyx ×12. All from *Forster PIF39595* (BRI). Del. W.Smith.

widespread; however, usually these vary more or less continuously in length with the more obvious cover of fully developed indumentum.

Both populations of this species contained many plants in 2013 and no other species of the genus were present reinforcing the hypothesis that these plants are not the result of any recent hybridisation event. The overall morphology of *Plectranthus bipartitus* is also hard to reconcile with a stabilised hybrid combination from the other species that are present. The apparent (this could be negated with further survey) marked disjunction at the ends of the tableland is repeated to some extent by that of *P. bellus*, although this latter species is known from more populations.

***Conservation status*:** Two populations are known for *Plectranthus bipartitus*. Both occur in a National Park; however, as noted for *P. bellus* (Forster 2011), the granite pavement and boulder fields habitats of the Hann Tableland are besieged by a range of alien naturalised species, especially feral pasture grasses such as *Andropogon gayanus* Kunth, *Melinis minutiflora* P.Beauv, *M. repens* (Willd.) Zizka, *Sporobolus pyramidalis* P.Beauv.and the daisies *Bidens pilosa* L. and *Praxelis clematidea* R.M.King & H.Rob. An appropriate conservation status is **Endangered** based upon the IUCN (2001) criterion D.

***Etymology*:** The specific epithet is derived from the Latin *bipartitio* (division into two) and alludes to the structures of the individual cymes.

Plectranthus splendens P.I.Forst., **sp. nov.** differing from *P. apreptus* S.T.Blake by being a much more robust erect herb to subshrub (versus a weakly decumbent herb) with strongly scented ± firm fleshy foliage with red sessile glands (versus scentless lax foliage with yellow sessile glands), the leaves have fewer teeth (5–8 per margin) that are longer (up to 8 mm long) (versus leaves with more teeth [7–15 per margin] that are shorter [up to 3 mm long]) and the inflorescence is initially weakly comose with much larger (3.2–4 mm long) bracts (versus an inflorescence that is not weakly comose and has much smaller (1.2–1.8 mm long) bracts). **Typus:** Queensland. Cook District: Hann Tableland National Park, 8 April 2013, *P.I. Forster PIF39587* (holo: BRI [2 sheets + spirit]; iso: CNS, K, MEL *distribuendi*).

Erect to rarely decumbent subshrub to 100 cm high; foliage with very strong sickly sweet scent when crushed, scabrid; non-glandular and glandular trichomes uncoloured, sessile glands 8-celled, dark orange. Roots thickened fibrous. Stems square, erect to rarely straggling, fleshy-succulent, easily snapped without obvious stringy fibres, the lower parts up to 8 mm diameter, pale green to flushed purple, upper parts with persistent indumentum, non-glandular trichomes generally absent or rarely 6–9-celled and up to 0.8 mm long, glandular trichomes dense, to 0.8 mm, sessile glands absent. Leaves discolorous, petiolate; petioles 20–45 × 2–3.5 mm, channelled on top, non-glandular trichomes absent or scattered, divaricate and 6–8-celled to 0.8 mm long, glandular trichomes sparse to dense, to 0.8 mm, sessile glands absent; laminae broadly ovate to somewhat subcordate, rarely reniform-cordate, ± firm fleshy, keeled when young, flatter with age, 28–70(90) × 28–80(110) mm, dentate with 5–8 teeth up to 8 mm long on each margin, of similar length along margin, secondary teeth usually present; tip acute; base subcordate to truncate; upper surface glossy mid-green, scabrid, veins impressed, non-glandular trichomes sparse to dense, antrorse to divaricate, 6–8-celled up to 1 mm long, glandular trichomes sparse to dense, to 0.8 mm long, sessile glands absent; lower surface pale green to silver green (due to the indumentum) and sometimes with a reddish hue (due to sessile glands), scabrid, veins strongly raised, non-glandular trichomes sparse to dense, divaricate, 6–8-celled up to 1 mm long, glandular trichomes sparse to dense, to 0.8 mm long, sessile glands absent, or scattered to dense. Inflorescence up to 210 mm long, single with 1 or 2 side branches, pedunculate for 15–20 mm; axis square in cross-section, non-glandular trichomes absent or a few near vertillasters, divaricate, 6–8-celled up to 0.8 mm long, glandular trichomes dense,

up to 0.8 mm long, sessile glands absent; bracts broadly ovate to subcordate, 3.2–4 × 3.5–5 mm, loosely comose near top of inflorescence, but soon shed, non-glandular trichomes sparse, divaricate, 5–8-celled up to 0.5 mm long, glandular trichomes sparse to dense, up to 0.5 mm long, sessile glands occasional; cymes sessile; verticillasters 10–14-flowered, up to 13 mm apart; pedicels 3.6–6 × *c.* 0.4 mm, non-glandular trichomes occasional, divaricate, 4-celled up to 0.1 mm long, glandular trichomes sparse, up to 0.2 mm long, sessile glands absent. Flower calyces 2.2–2.5 mm long, non-glandular trichomes scattered, antrorse, 4-celled up to 0.2 mm long, glandular trichomes sparse, sessile glands sparse. Corolla 10–11 mm long, purple and white to deep blue-purple; tube 5.5–6 mm long, curved at *c.* 90° *c.* 3 mm from the base, not curved upwards, glabrous; upper lobes suborbicular, erect, 2.2–2.5 × 2.2–2.5 mm, non-glandular trichomes occasional, divaricate, 2–4-celled up to 0.2 mm long, glandular trichomes sparse, sessile glands occasional; lateral lobes oblong, 2–2.2 × *c.* 1 mm, glabrous, purple with central white blotch; lower lobe broadly ovate, 5.5–6 × 4–4.2 mm, non-glandular trichomes occasional, divaricate, 2–4-celled up to 0.1 mm long, glandular trichomes occasional, sessile glands occasional or absent; filaments filiform, 8–9 × *c.* 0.1 mm, lilac, fused for *c.* 3 mm from the base; anthers *c.* 0.4 × 0.3 mm; style filiform, 8–10 × *c.* 0.1 mm, lilac, bifid for *c.* 0.3 mm. Fruit calyces 3–3.3 mm long; upper lobe oblong-ovate, 1–1.2 × *c.* 1.5 mm; lateral lobes lanceolate-falcate, 1.2–1.3 × 0.8–0.9 mm; lower lobes lanceolate-falcate, 1.2–1.5 × 0.5–0.6 mm. Nutlets ± circular in outline, flattened to somewhat convex, 0.7–0.9 × 0.8–0.9 mm, glossy brown, somewhat tessellate. **Fig. 2.**

***Additional specimens examined*:** Queensland. Cook District: Northern end of Hann Tableland, NW of Mareeba, Apr 2005, *Wannan 3955 & Ray* (BRI, NSW), Oct 2005, *Wannan 4126 & Jago* (BRI); Hann Tableland NP, May 2010, *Forster PIF36941* (BRI, CNS), May 2010, *Forster PIF37194* (BRI, CNS, MEL), Mar 2012, *Mathieson MTM1299* (BRI, DNA), Apr 2013, *Forster PIF39592* (BRI, CNS, MEL, NSW), Apr 2013, *Forster PIF39725* (BRI, CNS, MEL, NSW); Hann Tableland, near radio tower (cult Tolga), May 1995, *Sankowsky 1467 & Sankowsky* (BRI), Jul 1995, *Forster PIF17165* (BRI, CNS, DNA, L, MEL, NE, PE); Hann Tableland, near Radar Station, May 2004, *McDonald KRM2471* (BRI, DNA, MEL, NSW), May 2006, *Forster PIF31718 & McDonald* (BRI, MEL, NE, NSW); Hann Tableland, NW of Mareeba, Oct 1973, *Webb & Tracey 11649* (BRI); Boyle Pocket, Hann Tableland, Mar 2000, *Thompson SLT2613* (BRI).

***Distribution and habitat*:** *Plectranthus splendens* is endemic to the Hann Tableland (**Map 1**) where it is widespread – occurring predominantly on areas of pavement, but is also to be found on large boulders within areas of woodland or open forest. It is the most widespread *Plectranthus* on the Hann Tableland after *P. spectabilis* and the two species are sometimes sympatric.

***Notes*:** *Plectranthus splendens* might be related (on the basis of morphology) to the more coastal occurring *P. apreptus* S.T.Blake and some collections from the Hann Tableland have been identified and distributed under that name. The two species differ in a number of characters. *P. splendens* is a much more robust erect herb to subshrub with strongly scented ± firm fleshy foliage with red sessile glands, the leaves have fewer teeth (5–8 per margin) that are longer (up to 8 mm long) and the inflorescence is initially weakly comose with much larger (3.2–4 mm long) bracts. By comparison *P. apreptus* is a weakly decumbent herb with yellow sessile glands, scentless thin fleshy foliage, the leaves have more teeth (7–15 per margin) that are shorter (up to 3 mm long), the inflorescence is not weakly comose and has much smaller (1.2–1.8 mm long) bracts.

The populations from the Hann Tableland included within this species vary in the degree of indumentum cover and the disposition of the sessile glands on the foliage. Some plants (generally throughout a whole population) have noticeably shaggier foliage (due to greater density of indumentum) than others. A couple of populations have very dense red sessile glands on the leaf undersurface that impart a reddish colour to the surface; however, this feature seems to be variable and can be more or less absent.

This attractive species appears to have been first collected by Len Webb and Geoff Tracey in their pioneering botanical explorations of

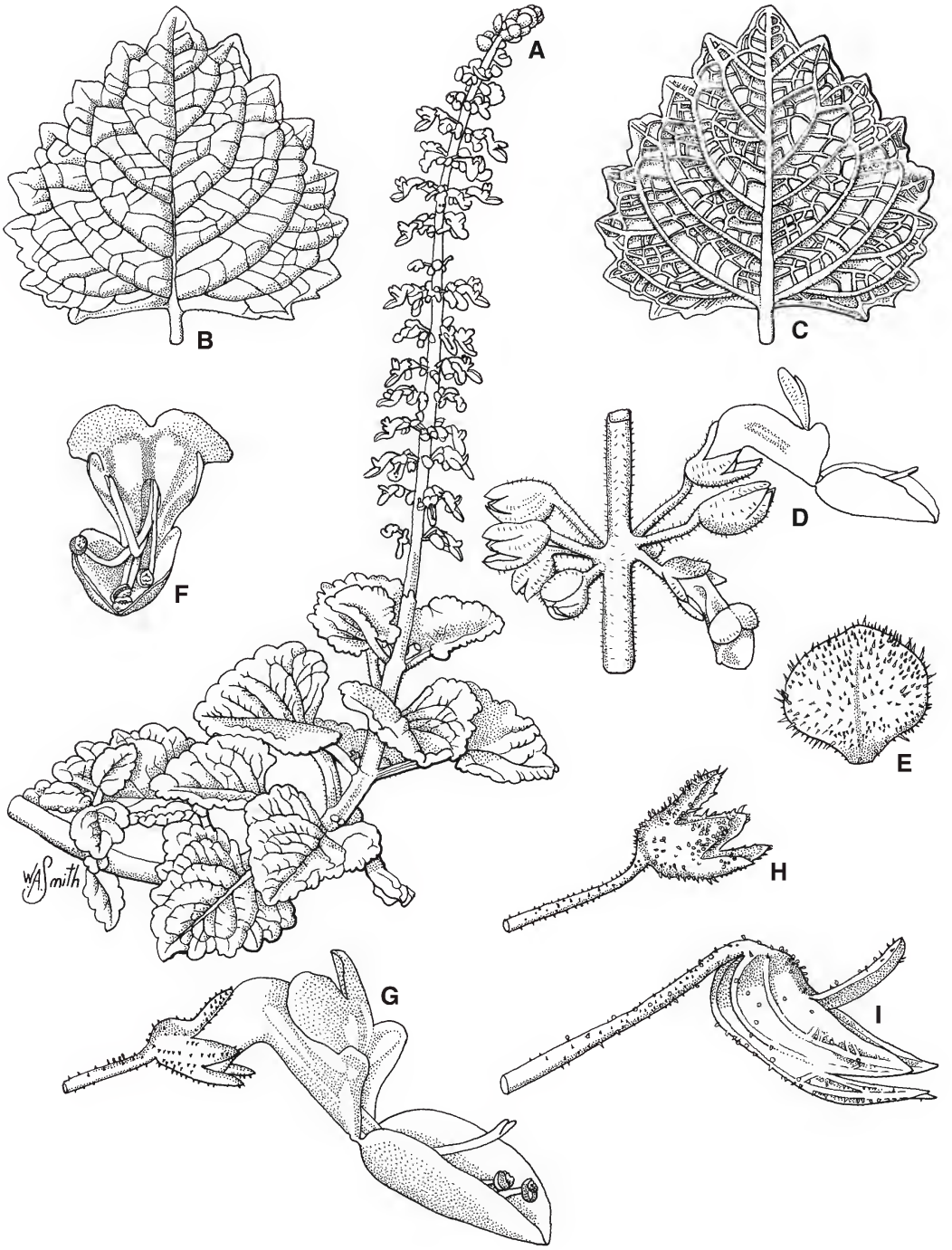

Fig. 2. ***Plectranthus splendens***. A. habit of flowering stem ×0.5. B. adaxial leaf surface ×1. C. abaxial leaf surface ×1. D. verticillaster ×4. E. floral bract ×4. F. lateral view of flower ×6. G. face view of flower ×6. H. lateral view of flower pedicel and calyx ×8. I. lateral view of fruiting pedicel and calyx ×8. All from *Forster PIF39587* (BRI). Del. W.Smith.

the Hann Tableland rainforests in 1973. The species is likely to become widespread in cultivation as it is easy to grow in frost free gardens and spreads vigorously by layering. Most material already in cultivation by native plant enthusiasts emanates from the population near the radar station based on a collection made by Garry and Nada Sankowsky prior to 1995. This particular population of plants is notable for the more or less complete absence of red sessile glands from the leaf undersurface.

***Conservation status*:** *Plectranthus splendens* is widespread on the Hann Tableland with most of the known populations present in the National Park. As noted for *P. bellus* (Forster 2011) and for *P. bipartitus* (above), the habitats where this species occurs are besieged by alien invasive weeds. In 2013, the populations of *P. splendens* were little affected by these weed invasions; however, it is difficult to predict what may eventuate in the future as the aliens expand their distribution. An appropriate conservation coding for *P. splendens* is **Vulnerable**, based on the criterion D2 (IUCN 2001).

***Etymology*:** The specific epithet is derived from the Latin *splendens* and alludes to the attractive appearance of this plant.

Acknowledgements

Some of the cited field collections were made on Bush Blitz (Commonwealth Government) supported expeditions in 2010 and 2013. Assistance with field work and plant material was provided by Garry and Nada Sankowsky (Tolga), Keith McDonald (Atherton), Mike Mathieson and Megan Thomas (Queensland Herbarium); traditional owners for the Hann Tableland (John & Troy Grainer), National Parks & Wildlife Service staff (Jonathon Roth, Robert Miller). Cape York Helicopters provided excellent logistical support.

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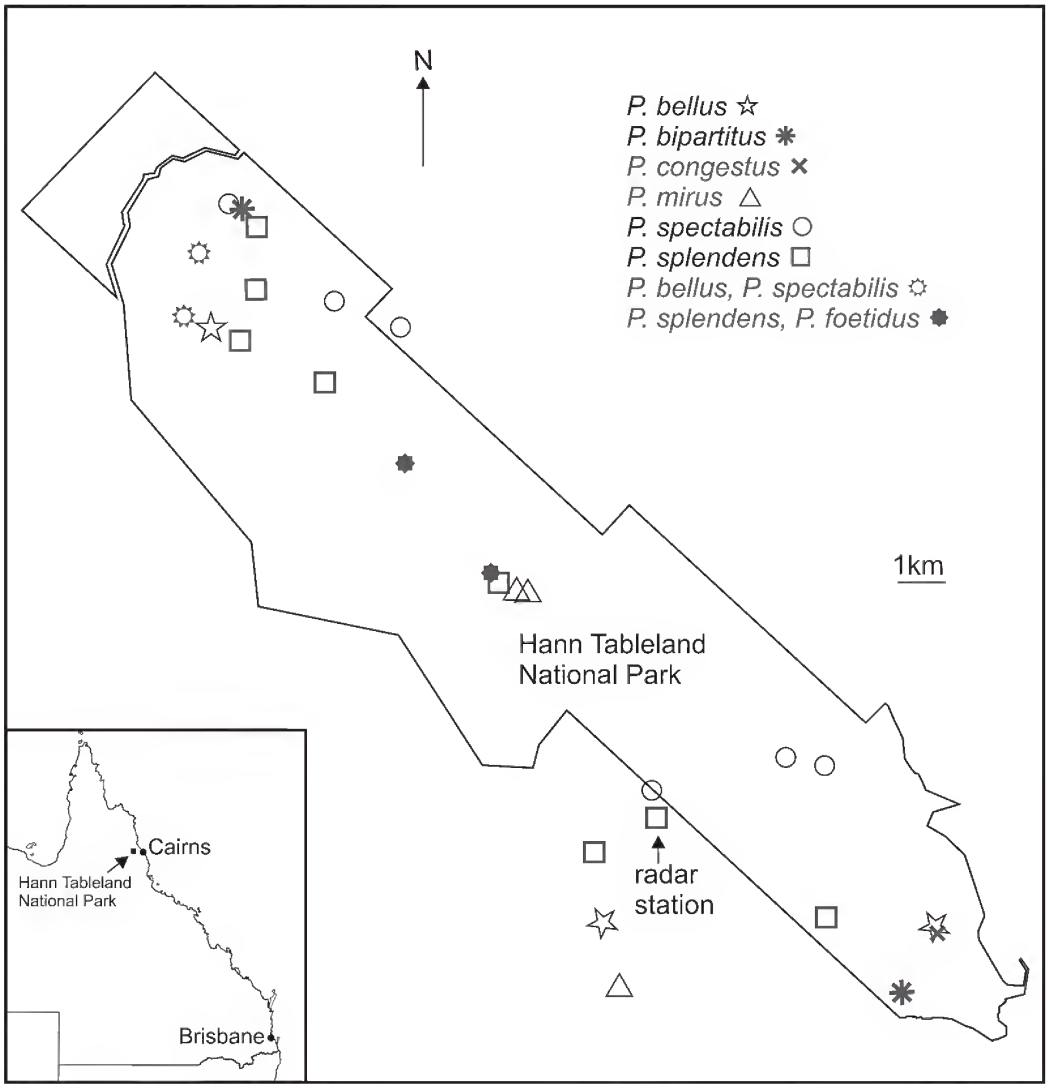

Map 1. Distribution of *Plectranthus* species on the Hann Tableland, north-east Queensland. Outline indicates the extent of the National Park.

Four new Queensland species of *Solanum* L. allied to *S. ellipticum* R.Br. (Solanaceae)

A.R. Bean

Summary

Bean, A.R. (2014). Four new Queensland species of *Solanum* L. allied to *S. ellipticum* R.Br. (Solanaceae). ***Austrobaileya* 9(2): 216–228**. Four new species of the *Solanum ellipticum* species group are described, *viz. Solanum adoxum* A.R.Bean, *S. capitaneum* A.R.Bean, *S. prolatum* A.R.Bean and the new combination *S. chillagoense* (Domin) A.R.Bean. The phenetic relationships between these and other taxa of the *S. ellipticum* group are clarified by the results of a morphometric analysis, using 18 quantitative characters and 25 operational taxonomic units. The new taxa are illustrated and maps of their distributions provided as is a map of *S. ellipticum*. An identification key for all Queensland species of the *S. ellipticum* group is provided. *Solanum dianthophorum* Dunal is formally placed in synonymy with *S. ellipticum* R.Br.

Key Words: Solanaceae, *Solanum ellipticum*, *Solanum adoxum*, *Solanum capitaneum*, *Solanum chillagoense*, *Solanum prolatum*, Australia flora, Queensland flora, taxonomy, morphometrics, new species, identification key, conservation status

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Introduction

Solanum ellipticum R.Br. has long been regarded as a taxonomically challenging species, encompassing a broad range of morphological forms. Symon (1981: 193) referred to "the cluster of species in the *S. ellipticum* R.Br. complex". Bean (2004) included a key to 16 informal taxonomic species-groups occurring in Australia, based on the groupings of Whalen (1984). The *Solanum ellipticum* group (Group 27), which is endemic to Australia, is one of these. In this key, the *Solanum ellipticum* group was distinguished by having green to yellow non-juicy fruits larger than 12 mm diameter, monomorphic flowers, calyx prickles 10–200 per flower, leaves with stellate hairs, calyx not accrescent, leaves more or less entire, and finger hairs rarely present. Bean (2004) included ten species in the *Solanum ellipticum* group, including two new species (*S. crebrispinum* A.R.Bean, *S. senticosum* A.R.Bean). In a more recent paper devoted to the *Solanum ellipticum* group (Bean 2011), 13 species were enumerated, after the description of four new species, reinstatement of two species, and the exclusion of three species from the group membership.

The present paper is devoted to the taxonomy of *Solanum ellipticum sens. lat.* in tropical Queensland, the centre of diversity for the *S. ellipticum* group. A morphometric analysis of data for several species in this group has been carried out. Morphometric studies have proved useful in helping define species limits in *Solanum* (Alvarez *et al.* 2008; Strickland-Constable *et al.* 2010). In the current paper, a morphometric analysis, illustrated by a dendrogram and ordination plot, supports the recognition of four new species (*S. adoxum, S. capitaneum, S. chillagoense* and *S. prolatum*) in the *S. ellipticum* group.

An interactive key (Bean 2012- onwards), covering the *Solanum* species of eastern and northern Australia, is available on the DELTA website.

Materials and methods

This revision is based on an examination of herbarium specimens at BRI. Measurements of floral parts and fruits were made using

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material preserved in spirit, or reconstituted in boiling water. Terminology follows Bean (2004). The distribution maps were compiled using DIVA-GIS Version 7.5.0, using label data of specimens at BRI.

Specimens of *Solanum ellipticum sens. lat.* were arranged into groups (putative taxa), based on their overall morphology. A selection of the most complete specimens from each group was then used for detailed measurements, with the individual herbarium specimens being the Operational Taxonomic Units (OTUs).

The groups were labelled with an informal name that refers to the locality of at least some of the specimens, and the OTUs within each group were numbered, i.e. Newcastle 1, 2 & 3; Hughenden 1, 2, 3 & 4; Chillagoe 1, 2 & 3; Ravenswood 1 & 2 and Edgbaston 1 & 2. Also included in the analysis were three samples of *S. ellipticum sens. str.*, two of *S. callosum* A.R.Bean, three of *S. crebrispinum* (postulated to be the closest relative of 'Newcastle'), and three of *S. cleistogamum* Symon (a close relative of 'Edgbaston' and 'Ravenswood').

A morphometric analysis was performed to help elucidate the phenetic relationships between the OTUs, and to assist in defining taxa. The analysis was done using Patn software, Version 2.30 (Belbin 2004), using 18 quantitative characters (**Table 1**), and 25 OTUs. The characters chosen were considered to be potentially useful in separating putative taxa, and have proved useful in previous *Solanum* taxonomic studies e.g. Bean (2004), Strickland-Constable *et al.* (2010). The author aimed to make 10 measurements per character per OTU, but this was often not possible, for example when fewer than 10 structures were available for measurement, or the structure was absent altogether. The mean value for each set of measurements was then calculated for each OTU. The values for Character 1 were recalculated using a Log (base 10) transformation, and the values for Character 3 were recalculated using a square root transformation. This was done so that these characters did not dominate the analysis, because of their large values and large range of values (Belbin 2004). The final matrix was then imported into Patn.

A hierarchical classification, using Gower's metric association measure and flexible UPGMA was produced (**Fig. 1**) and *a priori* grouping was not invoked. The ordination analysis used semi-strong hybrid multidimensional scaling (SSH) to produce a three-dimensional and a two-dimensional plot of the phenetic distance between the OTUs (**Fig. 2**). Various numbers of groups were tried in preliminary analyses, but in the final analysis, eight groups were specified.

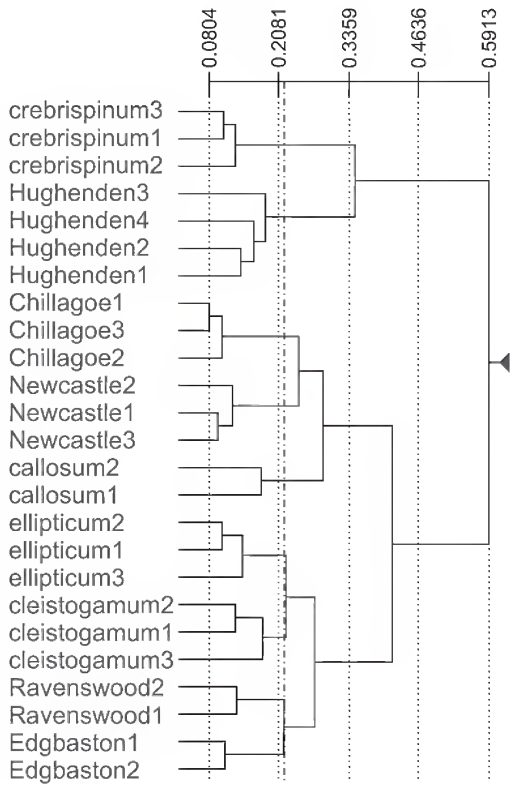

Fig. 1. UPGMA dendrogram generated from agglomerative group fusion using Gower's metric association measure.

Table 1. Characters used in the morphometric analysis.

The Kruskal-Wallis (KW) statistic cited for each character gives an indication of the value of each character, i.e. the higher the value, the greater is the utility of that character in discriminating between the groups.

	Character	KW value
1.	Leaf length (mm). The largest leaves on each specimen were measured	17.633
2.	Ratio between leaf length and leaf width, for the leaves measured in Character 1	16.428
3.	Prickles per cm of branchlet. Between two and four sections of branchlet were chosen for measurement on each specimen	22.341
4.	Number of stellate hairs per 0.25 mm^2 of the upper leaf surface. A hair was counted as present only if the attachment point was within the rectangular area measured	14.096
5.	Number of prickles on the upper leaf surface. Leaves were examined under the microscope as sometimes prickles are as short as 1 mm	19.059
6.	Stellate hair diameter (mm), upper leaf surface. Where multiple layers of hairs were present, only the uppermost hairs were measured	22.058
7.	Ratio of length of central ray to lateral rays of stellate hair (upper leaf surface)	15.345
8.	Longest stalk of stellate hair visible in the field of view (upper leaf surface	21.510
9.	Stellate hair diameter (mm), lower leaf surface. Where multiple layers of hairs were present, only the uppermost hairs were measured	21.267
10.	Ratio of length of central ray and lateral rays of stellate hair (lower leaf surface).	11.541
11.	Longest stalk of stellate hair visible in the field of view (lower leaf surface)	21.185
12.	Flower number per inflorescence. This measurement includes scars where flowers have abscised.	20.361
13.	13. Inflorescence rachis length (mm).	19.817
14.	14. Number of prickles on the calyx.	18.625
15.	Calyx lobe length at anthesis (mm). Only flowers at or very close to anthesis were measured, as calyx lobes lengthen as the bud/flower ages	16.177
16.	Corolla, ratio of apex length: sinus length. Large values indicate a deeply divided "stellate" corolla, while small values indicate a pentagonal or rotate corolla	17.585
17.	Fruiting pedicel length (mm)	11.285
18.	Peduncle length of basal fruit (mm). This is the distance from the base of the inflorescence to the first fruit attachment or scar	17.041

Results

The PATN analysis revealed eight or nine distinct taxon groupings in the UPGMA dendrogram (**Fig. 1**), and these are largely congruent with the putative taxon sorting originally made. When the data were analysed again using untransformed values for Characters 1 and 3, the same taxon groupings were obtained. Transforming the values for Characters 1 and 3 affected only the Ordination stress value, which was reduced from 0.0899 to 0.0825.

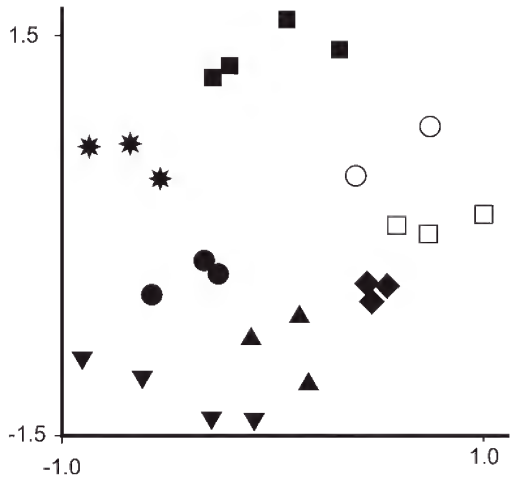

Fig. 2. Two dimensional ordination of the OTUs, using semi-strong hybrid multidimensional scaling (SSH). The minimum spanning tree is shown, with eight groups distinguished by different symbols.
▼ *S. adoxum*, ○ *S.callosum*, □ *S. capitaneum*, ◆ *S. chillagoense*, ✸ *S. crebrispinum*, ▲ *S. cleistogamum*, ● *S. ellipticum*, ■ *S. prolatum*.

Eight taxon groups are distinguished in a 2-dimensional ordination, with minimum spanning tree (**Fig. 2**). These groups are accepted here as taxa at species rank. Species rank is appropriate because each taxon differs from all its relatives by at least four characters, and because the phenetic differences between the putative new species are as great as or greater than the differences between established species e.g. *S. ellipticum* and *S. cleistogamum* (**Fig. 1**).

The 'Edgbaston' and 'Ravenswood' specimens were originally placed in separate groups, as the two 'Ravenswood' specimens differ from the two 'Edgbaston' in a number of characters, e.g. the broader leaves, the abundant glandular stellate hairs, the somewhat larger-diameter stellate hairs, and the numerous stellate hairs with a very long central ray. The differences are reflected by their strong separation on the dendrogram. However, I believe that these morphological differences are largely due to the juvenile nature of the available 'Ravenswood' specimens. The 'Edgbaston' specimens are from older, fully adult plants, lacking any juvenile growth or new shoots – they do also possess the distinctive indumentum characters mentioned above, but at very low frequencies, and their leaves are narrower.

Taxonomy

Solanum adoxum A.R.Bean **sp. nov.** affinis *S. cleistogamo* sed habitu erecto usque fuso, foliis angustioribus basibus cuneatis praeditis, corolla profunde lobata et praesentia in crescentia juvenili pilorum stellatorum glandibus apicalibus instructorum, differens. **Typus:** Queensland. Mitchell District: Near Measuring Spring, Edgbaston Reserve, NE of Aramac, 6 April 2012, *A.R. Bean 31650* (holo: BRI; iso: CANB).

Sprawling to erect, rhizomatous perennial shrub, 0.2–0.8 m high. Branchlets green to yellow; prickles 0–3 per cm, straight, acicular or broad-based, 1.5–6 mm long, 5–10 times longer than wide, with stellate hairs throughout lower part or glabrous; stellate hairs dense, 0.3–0.5 mm diameter, stalks 0–0.1 mm long; lateral rays 6–8, porrect; central ray 0.6–2 times as long as laterals, gland-tipped or not gland-tipped; gland-tipped finger hairs absent or present, type 2 hairs absent. Adult leaves elliptical, entire, 1.8–3.7 cm long, 0.6–1.2 cm wide, 2.9–4.1 times longer than broad; apex obtuse, base cuneate, oblique part 0–2 mm long, obliqueness index 0–6 percent; petioles 0.6–1.2 cm long, 23–43% length of lamina, prickles present or absent. Upper leaf surface green to grey; prickles absent; stellate hairs distributed throughout, protostellae absent, hair density sparse to dense, 0.1–0.4 mm apart, 0.3–0.7 mm across, stalks absent or to 0.1 mm long, lateral rays 7–8, porrect; central ray 0.5–1.0 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Lower leaf surface greenish to white or grey; prickles absent; stellate hairs sparse to very dense; 0.05–0.4 mm apart, 0.4–0.8 mm diameter, stalks absent or to 0.1 mm long; lateral rays 5–8, porrect; central ray 0.4–0.9 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose); common peduncle 1–26 mm long; rachis 1–45 mm long, prickles present; 2–5-flowered, with all flowers

bisexual, 5-merous; pedicels at anthesis 7–9 mm long, same thickness throughout, prickles absent or present. Calyx tube at anthesis 1.5–2.5 mm long; calyx lobes at anthesis deltate, 1.2–2.1 mm long; calyx prickles 8–26 per flower, 1–3 mm long; calyx stellae dense to very dense, transparent to white or yellow, 0.25–0.5 mm across, stalks absent or to 0.05 mm long, lateral rays 4–8, central ray 0.7–4 times as long as laterals, gland-tipped or not gland-tipped, gland-tipped simple hairs present or absent, type 2 hairs absent. Corolla purple, 7–9 mm long, deeply lobed, inner surface glabrous; anthers 3.0–4.7 mm long; filaments 0.2–0.3 mm long; ovary glabrous or with type 2 hairs; functional style 5–6.5 mm long, protruding between anthers, glabrous or with type 2 hairs. Fruiting calyx lobes less than or more than half length of mature fruit, prickles 1–3.5 mm long; mature fruits 1–4 per inflorescence, globose, *c.* 8 mm diameter, pedicels 11–21 mm long. Mature fruits not seen. Juvenile leaves ovate, 3.4–4.4 cm long, 1.4–2.5 cm wide, prickles absent; stellate hairs 0.45–0.55 mm diameter, some with eglandular central ray 4–11 times as long as laterals, others with glandular central ray 0.6–1 times as long as laterals, lateral rays also often glandular; gland-tipped simple hairs frequent, 0.1–0.2 mm long. **Fig. 3A–E.**

***Additional specimens examined*:** Queensland. MITCHELL DISTRICT: 93 km E of Muttaburra on stock route through Sumana Station, Apr 2011, *Thompson MUT446 & Edginton* (AD, BRI); Edgbaston, NE of Aramac, Apr 2014, *Fensham 6399* (BRI); Ravenswood Station, 20 km ENE of Aramac, May 2006, *Thompson MUT312 & Wilson* (BRI); Ravenswood Station, 20 km E of Aramac, Apr 2012, *Bean 31745* (BRI).

***Distribution and habitat*:** *Solanum adoxum* is known from three localities – Ravenswood Station; Edgbaston Reserve; and Sumana, E of Muttaburra (**Map 1**). At the latter two localities, it grows on weathered sand dunes in association with *Triodia longiceps* J.M.Black. At Ravenswood, it has been found in a cleared area, formerly Gidgee (*Acacia cambagei* R.T.Baker) woodland, on sandy soil.

***Phenology*:** Flowers and fruits have been recorded for April and May.

***Affinities*:** *Solanum adoxum* is allied to *S. cleistogamum*, but differs from it by the upright to sprawling habit (prostrate for *S. cleistogamum*), the narrower leaves with cuneate leaf bases; the deeply lobed corolla (rotate for *S. cleistogamum*); the glandular stellate hairs and gland-tipped simple hairs on pedicels and branchlets, at least on young growth and juvenile plants (no glandular hairs for *S. cleistogamum*), the presence of stellate hairs with a very long central ray (4–11 times the laterals), at least on young growth and juvenile plants (stellate hairs with a very long central ray absent for *S. cleistogamum*).

***Conservation status*:** *Solanum adoxum* is known from just three subpopulations. The Ravenswood subpopulation is very small and extinction at that site is predicted due to grazing pressure. The Edgbaston site is within a Bush Heritage reserve, and should be stable, but fewer than 100 plants are known there. About six plants were observed in the Sumana subpopulation (E.J. Thompson, *pers. comm.* 2014), and the site is on a stock route. A conservation status of **Endangered** is recommended (IUCN 2001). EN B1ab(ii,iv) + 2ab(ii,iv); C1.

***Etymology*:** From the Greek *adoxos*, meaning 'without glory' or 'obscure'. This refers to its rather straggly habit and the lack of ornamental features.

Solanum capitaneum A.R.Bean **sp. nov.** affinis *S. crebrispino* sed inflorescentiis 6–12-floris, aculeis brevioribus in ramulis, aculeis 4–22 in calyce (adversum 50–70 in *S. crebrispino*) et pilis stellatis sparsis usque moderate densis in pagina superiore foliorum, differens. **Typus:** Queensland. COOK DISTRICT: 3.6 km by road from Forsayth towards Georgetown, 3 February 2006, *K.R. McDonald KRM4857* (holo: BRI; iso: BM).

Solanum sp. (Newcastle Range D.E. Symon 4907); Henderson (2002).

Sprawling to erect, rhizomatous perennial shrub, 0.2–0.3 m high. Branchlets yellow, rusty or brown; prickles 4–26 per cm, straight, acicular, 1–4 mm long, 7–11 times longer than wide, with stellate hairs throughout lower part; stellate hairs very dense, 1.1–1.4 mm diameter, stalks 0–0.3 mm long; lateral rays 6–8, porrect; central ray 1–1.5 times

as long as laterals, not gland-tipped; type 2 hairs absent. Adult leaves ovate, entire, 8.6–13.6 cm long, 3.1–5.3 cm wide, 2.1–2.8 times longer than broad; apex obtuse or acute, base cuneate or obtuse, oblique part 3–8 mm long, obliqueness index 3–6 percent; petioles 1.6–3.4 cm long, 18–25% length of lamina, prickles present. Upper leaf surface green; prickles absent or present on midvein only, 0–4, straight, acicular, 2–3 mm long; stellate hairs distributed throughout, protostellae present, hair density sparse or moderate, 0.5–1 mm apart, 1–1.7 mm across, stalks absent or to 0.3 mm long, lateral rays 6–8, porrect; central ray 0.9–1.3 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Lower leaf surface greenish-white, white, or grey; prickles absent; stellate hair density moderate or dense; 0.25–0.4 mm apart, 1–1.7 mm diameter, stalks 0.1–0.6 mm long; lateral rays 6–8, porrect; central ray 0.6–1.1 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose) or 2-branched; common peduncle 16–38 mm long; rachis 45–110 mm long, prickles present; 6–12-flowered, with all flowers bisexual, 5-merous; pedicels at anthesis 9–11 mm long, same thickness throughout, prickles absent or present. Calyx tube at anthesis 2–2.5 mm long; calyx lobes at anthesis attenuate, 1–4 mm long; calyx prickles 4–22 per flower, 1.5–4 mm long; calyx stellae very dense, white or transparent or brown or rusty, 1–1.2 mm across, stalks 0–0.3 mm long, lateral rays 5–7, central ray 0.9–1.5 times as long as laterals, not gland-tipped, simple hairs absent, type 2 hairs absent. Corolla purple, 13–15 mm long, rotate or shallowly lobed, inner surface glabrous; anthers 6–6.7 mm long; filaments 0.2–0.3 mm long; ovary with Type 2 hairs only; functional style 7.5–9 mm long, protruding between anthers, glabrous. Fruiting calyx lobes less than half length of mature fruit, prickles 2–3 mm long; mature fruits 3–6 per inflorescence, globular, *c.* 17 mm diameter, 2-locular; placenta stalked, anvil-shaped; interior moist but not juicy, pericarp 0.8–1.4 mm thick; pedicels 12–16 mm long. **Fig. 3F-J.**

***Additional specimens examined*: Queensland.** Cook District: Blackdown, 2.5 km WNW of Nundah Creek crossing, Nov 2000, *Ford AF2489* (BRI); Alma-den, undated, *Bick s.n.* (BRI [AQ332188]); 68.4 km by road W of Mt Surprise, Newcastle Range, Mar 2006, *McDonald KRM4929* (BRI); Agate Creek fossicking area, Apr 2006, *McDonald KRM5207* (BRI); Newcastle Range, near Georgetown, Jan 2001, *McDonald KRM700* (BRI); *c.* 32 km E of Georgetown, May 1967, *Symon 4904, 4907* (AD, BRI, CANB, K, MO); Newcastle Range, Routh Gorge, Jan 1983, *Sankowsky 242 & Sankowsky* (BRI); 5.6 km along Agate Creek Road from junction at Forsayth, Apr 2006, *McDonald KRM5144* (BRI); 3 km W of Forsayth, Apr 2003, *Wannan 2808 & Graham* (BRI); *c.* 32 km E of Georgetown, May 1967, *Symon 4906* (AD, BRI, MO); 67.3 km by road from Mt Surprise, Newcastle Range, Apr 2006, *McDonald KRM5116* (BRI); Townley, S of Georgetown, Jul 2001, *Fensham 4565* (BRI); Bagstowe, Stuarts Spring Nature Refuge, *c.* 95 km S of Georgetown, May 2011, *Mathieson MTM1054* (BRI).

***Distribution and habitat*:** *Solanum capitaneum* is found mainly around Georgetown and Forsayth, with several records from the Newcastle Range. There is also an old record from Alma-den (**Map 1**). Most (if not all) records are from eucalypt woodland with sandy soil on granite substrate.

***Phenology*:** Flowers have been recorded from November to July; mature fruits from January to July.

***Affinities*:** *Solanum capitaneum* is distinguished within the *S. ellipticum* group by its large stellate hairs, well-spaced on the upper leaf surface, and the sometimes branched inflorescence bearing 6–12 flowers. It is close to *S. crebrispinum*, but differs by the prickles on the branchlets < 6 mm long (up to 11 mm long for *S. crebrispinum*), the narrower leaves, 2.1–2.8 times longer than wide (vs. 1.5–2.1 times for *S. crebrispinum*), the upper leaf surface with sparse to moderately dense stellate hairs (vs. dense for *S. crebrispinum*) on stalks no longer than 0.3 mm (stalks to 0.9 mm for *S. crebrispinum*); the absence of prickles on the lower leaf surface (present for *S. crebrispinum*); the 6–12-flowered inflorescences (3–5-flowered for *S. crebrispinum*); flowers on pedicels 9–11 mm long (4–6 mm long for *S. crebrispinum*); and the calyx prickles 4–22 per flower (50–70 per flower for *S. crebrispinum*).

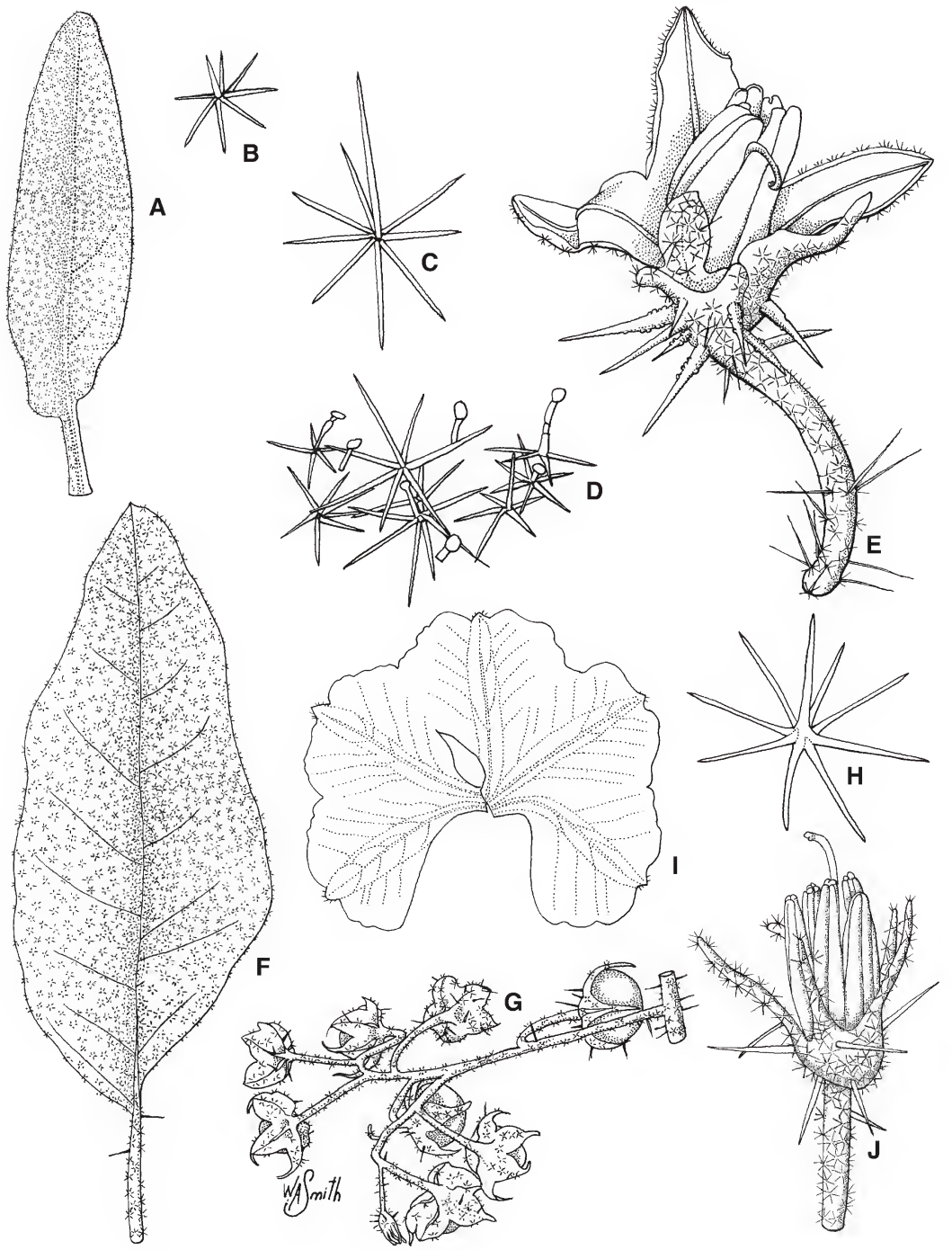

Fig. 3A–E: ***Solanum adoxum*** A. adult leaf ×2. B. stellate hair with short central ray ×48. C. stellate hair with long central ray ×48. D. branchlet indumentum with a mixture of stellate and simple glandular hairs ×48. E. flower at anthesis ×6. **F–J:** ***S. capitaneum***. F. adult leaf ×1. G. infructescence ×1. H. stellate hair from upper leaf surface ×24. I. corolla ×2. J. flower at anthesis with corolla removed ×3. A–B from *Bean 31650* (BRI); C–D from *Thompson MUT312 & Wilson* (BRI); E from *Bean 31745* (BRI); F–J from *McDonald KRM4857* (BRI). Del. W. Smith.

***Conservation status*:** Although the geographic range of *Solanum capitaneum* is not large, it appears to be relatively common within that range. A status of **Least Concern** (IUCN 2001) is recommended.

***Etymology*:** The epithet is from the Latin *capitaneus*, head or chief, and refers to the larger size of stellate hairs in this species in comparison to most species in the *S. ellipticum* group.

Solanum chillagoense (Domin) A.R.Bean **comb. et stat. nov.**; *S. ellipticum* var. *chillagoense* Domin, *Biblioth. Bot.* 89: 588 (1929). **Type:** Queensland. Cook District: near Chillagoe, February 1910, *K. Domin s.n.* [*Iter Australiense No. 8299*] (lecto [here designated]: PR 530913, photo at BRI).

Solanum ellipticum f. *albiflora* Domin, *Biblioth. Bot.* 89: 588 (1929). **Type:** Queensland. Cook District: near Chillagoe, February 1910, *K. Domin s.n.* (holo: ?PR), *n.v.*

Sprawling to prostrate, rhizomatous perennial shrub, 0.2–0.3 m high. Branchlets white, yellow or brown; prickles 1–9 per cm, straight, acicular, 1–8 mm long, 8–11 times longer than wide, with stellate hairs throughout lower part or sometimes glabrous; stellate hairs very dense, 0.6–0.8 mm diameter, stalks 0–0.2 mm long; lateral rays 7–8, porrect; central ray 0.4–1.1 times as long as laterals, not gland-tipped; type 2 hairs absent. Adult leaves ovate, entire or obscurely lobed, 8.2–13.3 cm long, 3.4–4.6 cm wide, 2.2–2.9 times longer than broad; apex acuminate or acute, base cuneate, oblique part 2–7 mm long, obliqueness index 2–7 percent; petioles 2–3.5 cm long, 20–33% length of lamina, prickles present. Upper leaf surface green to grey-green; prickles absent or present on midvein only, 0–5, straight, acicular, 1–2 mm long; stellate hairs distributed throughout, protostellae absent, hair density moderate to dense, 0.25–0.35 mm apart, 0.6–0.8 mm across, stalks absent or to 0.15 mm long, lateral rays 7–9, porrect; central ray 0.4–1 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Lower leaf surface greenish-white to white; prickles absent; stellate hairs dense; 0.15–0.3 mm apart, 0.6–0.8 mm diameter, stalks 0–0.3 mm long; lateral rays 7–8, porrect; central ray 0.5–1 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose); common peduncle 13–34 mm long; rachis 35–65 mm long, prickles present; 6–9-flowered, with some flowers bisexual and some male, 5-merous; pedicels at anthesis 7–11 mm long, same thickness throughout, prickles absent or present. Calyx tube at anthesis 2.5–3 mm long; calyx lobes at anthesis attenuate, 2.5–8 mm long; calyx prickles 6–21 per flower, 0.5–3.5 mm long; calyx stellae very dense, white or yellow, 0.5–0.7 mm across, stalks 0–0.3 mm long, lateral rays 8, central ray 0.8–1.1 times as long as laterals, not gland-tipped, simple hairs absent, type 2 hairs absent. Corolla mauve to purple, 8–10 mm long, deeply lobed, inner surface glabrous; anthers 3.5–4.5 mm long; filaments 0.3–0.8 mm long; ovary with stellate hairs only; functional style 6–9 mm long, protruding between anthers, glabrous or with stellate hairs near base. Fruiting calyx lobes less than half length of mature fruit, prickles 1–3.5 mm long; mature fruits 1–3 per inflorescence, oblate, *c.* 18 mm diameter, 2-locular; placenta stalked, anvil-shaped; interior moist but not juicy, pericarp 2.5–3 mm thick; pedicels 15–18 mm long. Seeds pale yellow, 2.3–2.5 mm long. **Fig. 4A–E.**

***Additional specimens examined*:** Queensland. Cook District: Chillagoe Caves NP, Royal Archway section, Mungana, Jan 2002, *Forster PIF28141 et al.* (BRI); Chillagoe – Mungana Road, *c.* 200 m SE of Red Dome turnoff, Nov 2000, *Ford AF2487* (BRI, NSW); 12 km S of Chillagoe, Burke Developmental Road, Dec 1991, *Gray 5370* (BRI, CNS); Dome Rock, E of Chillagoe, Mar 2000, *McDonald KRM317* (BRI); 11 miles [16.6 km] S of Chillagoe, May 1967, *Symon 4874* (BRI); 14 km SSE of Chillagoe beside Burke Developmental Road, May 2006, *Wannan 4385 & Gray* (AD, BRI, NY); SE of Chillagoe, Mar 2000, *McDonald KRM338* (BRI); Metal Hills [Chillagoe – Mungana Caves] NP, N of Chillagoe, Feb 2007, *Little & Little s.n.* (BRI [AQ728603]); Burke Developmental Road, *c.* 200 m SE of Red Dome turnoff, Mungana, May 2001, *Ford AF2793* (BRI, NSW); Royal Arch Cave, Chillagoe NP, Mar 2000, *McDonald KRM337* (BRI).

***Distribution and habitat*:** *Solanum chillagoense* is known only from the Chillagoe area of north Queensland (**Map 1**). All of the occurrences (except one) are associated with

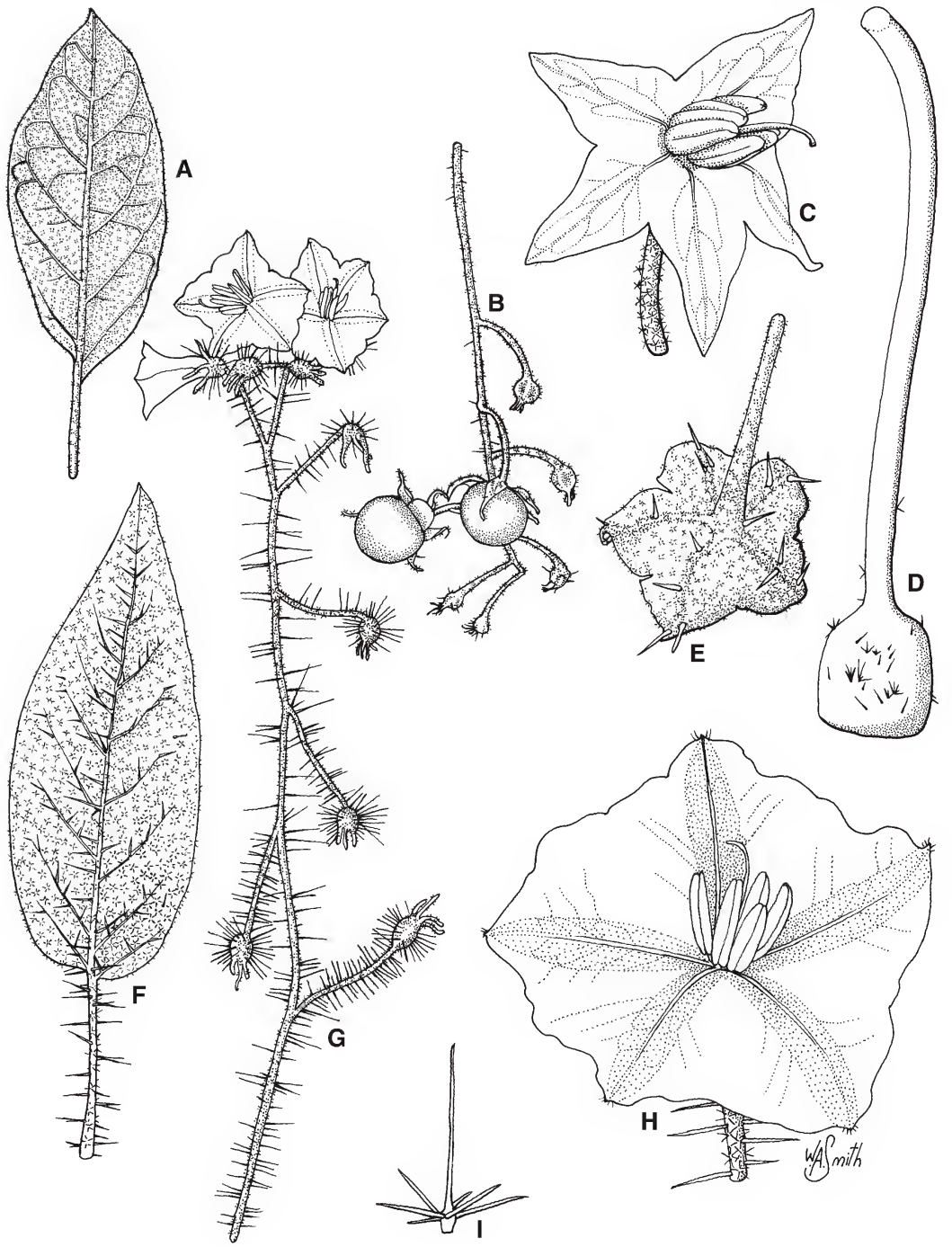

Fig. 4A–E: ***Solanum chillagoense***. A. adult leaf ×0.6. B. infructescence ×1. C. flower at anthesis ×3. D. style and ovary ×12. E. outer surface of fruiting calyx ×2. **F–I:** ***S. prolatum***. F. adult leaf ×0.6. G. inflorescence ×0.8. H. flower at anthesis ×2. I. stellate hair from upper leaf surface ×24. A–B from *McDonald KRM338* (BRI); C from *Forster PIF28141* (BRI); D–E from *McDonald KRM337* (BRI); F–H from *Cumming 23517* (BRI); I from *Johnson & Turpin s.n.* (BRI [AQ745940]). Del. W. Smith.

limestone karst, and several specimens are from semi-evergreen vine thicket.

***Phenology*:** Flowers have been recorded from November to May; mature fruits in May.

***Affinities*:** This species has been identified in the past as *Solanum ellipticum*. It differs from that species by the 6–9-flowered inflorescences (1–5-flowered for *S. ellipticum*), the distinctly oblate fruits (globose in *S. ellipticum*), the fruiting pericarp 2.5–3 mm thick (0.6–1 mm thick for *S. ellipticum*), the glabrous inner surface of the corolla (sparsely stellate-hairy for *S. ellipticum*), and the presence of dense stellate hairs on the ovary (glabrous or with Type 2 hairs for *S. ellipticum*). In addition, the calyx prickles on *S. chillagoense* occur only along the midribs.

***Conservation status*:** Although the geographic range of *Solanum chillagoense* is not large, it appears to be relatively common within that range. A status of **Least Concern** (IUCN 2001) is recommended.

Solanum prolatum A.R.Bean **sp. nov.** affinis *S. elliptico* sed aculeis multo magis in ramulis, aculeis 30–60 in pagina superiore foliorum, pilis stellatis in pagina superiore foliorum radio centrali radiis lateralibus 1.5–4 plo longiore praeditis, inflorescentiis 6–14-floris flores omnes bisexuales gerentibus et corolla rotata majore, differens. **Typus:** Queensland. Burke District: *c.* 4 km N of Solway Downs homestead, *c.* 90 km directly NW of Richmond, 14 November 1999, *D.C. Johnson & G.P. Turpin s.n.* (holo: BRI [AQ745940]).

Sprawling to prostrate, rhizomatous perennial shrub, up to 0.4 m high. Branchlets white, rusty or brown; prickles 24–98 per cm, straight, acicular, 2–8.5 mm long, 12–16 times longer than wide, glabrous; stellate hairs very dense, 0.7–1.1 mm diameter, stalks 0–0.5 mm long; lateral rays 7–8, porrect; central ray 0.8–1.3 times as long as laterals, not gland-tipped; type 2 hairs absent. Adult leaves ovate to broadly ovate, entire or obscurely lobed, 6.3–11.4 cm long, 4–6.2 cm wide, 1.6–2.4 times longer than broad; apex obtuse or acute, base obtuse to cordate, oblique part 2.5–7 mm long, obliqueness index 3–6 percent; petioles 2.4–4.8 cm long, 30–44% length of lamina, prickles present. Upper leaf surface green to grey-green; prickles present on midvein and lateral veins, 30–60, straight, acicular, 2–7 mm long; stellate hairs distributed throughout, protostellae absent, hairs dense, 0.1–0.4 mm apart, 0.6–1 mm across, stalks 0–0.5 mm long, lateral rays 7–8, porrect or ascending; central ray 1.5–4 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Lower leaf surface grey to white; prickles present on midvein and lateral veins, 13–23; stellate hairs dense to very dense, 0.1–0.25 mm apart, 0.8–1.2 mm diameter, stalks 0–1 mm long; lateral rays 7–8, porrect or ascending; central ray 1–2 times as long as laterals, not gland-tipped; simple hairs absent; type 2 hairs absent. Inflorescence supra-axillary, cymose (pseudo-racemose); common peduncle 22–43 mm long; rachis 36–82 mm long, prickles present; 6–14-flowered, all flowers bisexual, 5-merous; pedicels at anthesis 9–21 mm long, same thickness throughout, prickles present. Calyx tube at anthesis 1.5–3.5 mm long; calyx lobes at anthesis attenuate, 3.5–9 mm long; calyx prickles 36–82 per flower, 1–3.5 mm long; calyx stellae very dense, transparent or purplish, 0.7–1 mm across, stalks 0–0.5 mm long, lateral rays 6–8, central ray 2–3 times as long as laterals, not gland-tipped, simple hairs absent, type 2 hairs absent. Corolla purple, 16–18 mm long, rotate, inner surface glabrous; anthers 4.6–5.7 mm long; filaments 0.5–1.2 mm long; ovary glabrous; functional style 9–9.5 mm long, protruding between anthers, glabrous. Fruiting calyx lobes with prickles 2–3.5 mm long; pedicels 11–16 mm long. Mature fruits not seen. **Fig. 4F–I.**

***Additional specimens examined*:** Queensland. Burke District: Sussex Park, Flinders River, Jun 1934, *Blake 6258* (BRI); 16.8 km N of Kennedy Development Road near Hughenden towards Torver Valley, Aug 2005, *Cumming 23517* (AD, BRI). Mitchell District: 35 miles [58.2 km] S of Torrens Creek, Woura Park, Jun 1971, *Compton s.n.* (BRI [AQ039078]); Woura Park, 56 km S of Torrens Creek, Sep 1972, *Bode s.n.* (BRI [AQ005863]).

***Distribution and habitat*:** *Solanum prolatum* has a restricted distribution centred on the town of Hughenden (**Map 1**). At one location it occurs on the top of a breakaway with *Acacia cambagei*; at another it grows on a basalt slope

with *Corymbia dallachiana* (Benth.) K.D.Hill & L.A.S.Johnson and *C. terminalis* (F.Muell.) K.D.Hill & L.A.S.Johnson.

***Phenology*:** Flowers have been recorded between June and September. The fruiting period is unknown.

***Affinities*:** *Solanum prolatum* differs from *S. ellipticum* by the many more prickles on the branchlets, the obtuse to cordate leaf bases, the 30–60 prickles on the upper leaf surface (0–20 prickles for *S. ellipticum*), the stellate hairs on the upper leaf surface with a central ray 1.5–4 times the laterals (central ray 0.5–1 times for *S. ellipticum*), the 6–14 flowered inflorescences with all flowers bisexual (1–5 flowered with some flowers male for *S. ellipticum*), the corolla 16–18 mm long, rotate, glabrous on the inner surface (corolla 7–12 mm long, deeply to shallowly lobed, sparsely stellate hairy on inner surface for *S. ellipticum*).

***Conservation status*:** *Solanum prolatum* is known from just five specimens, but from quite a wide area. It is anticipated that more populations will be found, based on the availability of habitat. A status of **Data Deficient** (IUCN 2001) is therefore recommended.

***Etymology*:** From the Latin *prolatus*, meaning extended or elongated. This is in reference to the central ray of the stellate hairs, which is longer in this species than in any other of the *S. ellipticum* group.

Solanum ellipticum R.Br., *Prodr.* 446 (1810). **Type:** Queensland. Port Curtis District: Broadsound, 25 September 1802, *R. Brown* (lecto: BM, *fide* Symon [1981: 188]; isolecto: MPU).

Solanum dianthophorum Dunal, *Hist. Nat. Solanum* 183 (1813); *S. biflorum* R.Br., *nom. illeg., non* Lour. (1790), ***syn. nov.*** **Type:** Queensland. Port Curtis District: Port II, undated [Port Clinton, 21–23 August 1802], *R. Brown s.n.* [*Bennett number 2668*] (holo: BM).

For a description, see Bean (2011).

***Distribution and habitat*:** *Solanum ellipticum* is widespread in the eastern half of Queensland, excluding the far north and the high-rainfall areas of the south-east (**Map 2**). It grows on a diverse range of habitats and soils, where the drainage is good and high levels of sunlight are available.

***Notes*:** Bean (2004) accepted *Solanum dianthophorum* as a possibly distinct species, but restricted its use to the type specimen that was collected in what is now the Shoalwater Bay Training Area, north of Rockhampton. Recent biodiversity surveys there have resulted in the collection of several *Solanum ellipticum* specimens from a range of habitats. At least one of them was collected from littoral rainforest on sand near a beach. This is the presumed habitat of Brown's collection of *S. dianthophorum*, described by him as "arenosus prope littus". The absence of a distinct *S. dianthophorum*-like plant in that habitat (or any other habitat), combined with the presence of typical *S. ellipticum* there, has convinced me that the type of *S. dianthophorum* is merely an anomaly and that it should be reduced to synonymy with the widespread *S. ellipticum*.

Key to the Queensland species of the *Solanum ellipticum* group

1 Style eccentric, strongly bent near its base **2**
1. Style erect, sometimes curled near apex **3**

2 Branchlet hairs not floccose (stalks 0–0.2 mm); calyx prickles 0.5–2 mm long; corolla 9–13 mm long . . . . . **S. emmottii**
2. Branchlet hairs floccose (stalks 0–2 mm); calyx prickles 2–4 mm long; corolla 14–20 mm long . . . . . **S. lithophilum**

3 Inflorescences 1–5-flowered **4**
3. Inflorescences 6–12-flowered **10**

4 Calyx prickles more than 30 . . . . . **5**
4. Calyx prickles 0–30 . . . . . **7**

5 Branchlet prickles 0–10/cm; corolla inner surface sparsely hairy . . . . . **S. ellipticum**
5. Branchlet prickles 18–42/cm; corolla inner surface glabrous **6**

6 Leaves rusty-coloured, base cuneate; calyx stellate hairs 0.4–0.6 mm across; style and ovary glabrous; branchlet stellate hairs 0.6–0.9 mm diameter . . . . . **S. senticosum**
6. Leaves white to yellowish, base obtuse to cordate; calyx stellate hairs 0.7–0.9 mm across; style and ovary with short glandular hairs; branchlet stellate hairs 0.9–1.2 mm diameter . . . . . **S. crebrispinum**

7 Stellate hairs of upper leaf surface with a central ray 1.1–2 times longer than lateral rays; corolla rotate, white to mauve . . . . . **S. cleistogamum**
7. Stellate hairs of upper leaf surface with a central ray 0.5–1 times longer than lateral rays; corolla shallowly to deeply lobed, purple **8**

8 Adult leaves 0.7–1.2 cm wide, 2.9–4.1 times longer than broad, lower surface green; branchlets green. . . . . **S. adoxum**
8. Adult leaves 1.4–5.2 cm wide, 1.6–2.9 times longer than broad, lower surface greenish-white to grey; branchlets grey to brown **9**

9 Leaves 2.2–3.5 cm long, prickles absent from upper leaf surface; petioles 58–77% length of lamina; calyx prickles 0–4 . . . . . **S. unispinum**
9. Leaves 3.5–14 cm long, prickles 2–20 on upper leaf surface; petioles 20–45% length of lamina; calyx prickles (2–)5–30 . . . . . **S. ellipticum**

10 Stellate hairs of upper leaf surface with central ray 1.5–4 times longer than laterals; corolla 16–18 mm long, rotate . . . . . **S. prolatum**
10. Stellate hairs of upper leaf surface with central ray 0.4–1.3 times longer than laterals; corolla 8–15 mm long, deeply lobed or shallowly lobed. **11**

11 Stellate hairs of upper leaf surface 0.05–0.2 mm apart, centre to centre (dense to very dense) **12**
11. Stellate hairs of upper leaf surface 0.25–1.0 mm apart, centre to centre (sparse to dense). **13**

12 Stellate hairs consistently present on inner surface of corolla; rachis prickles present; branchlets terete; mature fruits 18–20 mm diameter . . . . **S. callosum**
12. Stellate hairs consistently absent from inner surface of corolla; rachis prickles absent; branchlets usually ridged; mature fruits 14–17 mm diameter . . . . . **S. quadriloculatum**

13 Stellate hairs of upper leaf surface 1–1.7 mm across, and 0.5–1 mm apart, centre to centre; all flowers bisexual; calyx prickles scattered; corolla 13–15 mm long, rotate or shallowly lobed; ovary with short glandular hairs only . . . . . **S. capitaneum**
13. Stellate hairs of upper leaf surface 0.6–0.8 mm across, and 0.25–0.35 mm apart, centre to centre; some flowers bisexual and some male; calyx prickles confined to midveins; corolla 8–10 mm long, deeply lobed; ovary with stellate hairs. . . . . **S. chillagoense**

Acknowledgements

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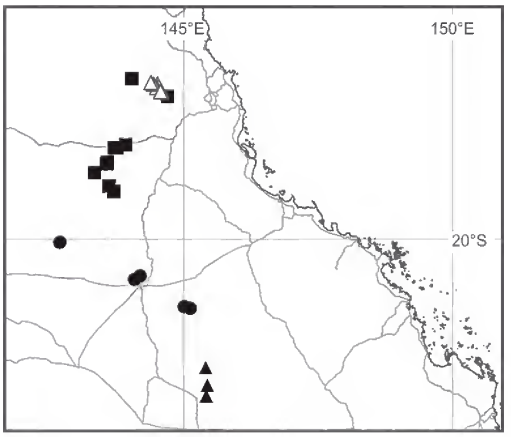
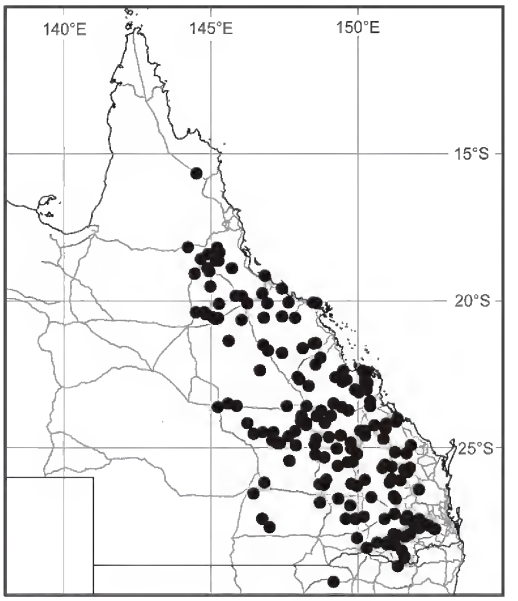


Map 1. Distribution of *Solanum adoxum* ▲, *S. capitaneum* ■, *S. chillagoense* △ and *S. prolatum* ● based on BRI specimens.



Map 2. Distribution of *Solanum ellipticum* based on BRI specimens.

Systematics of *Tephrosia* Pers. (Fabaceae: Millettiae) in Queensland: 1. A summary of the classification of the genus, with the recognition of two new species allied to *T. varians* (F.M.Bailey) C.T.White

Les Pedley

Summary

Pedley, L. (2014). Systematics of *Tephrosia* Pers. (Fabaceae: Millettiae) in Queensland: 1. A summary of the classification of the genus, with the recognition of two new species allied to *T. varians* (F.M.Bailey) C.T.White. ***Austrobaileya* 9(2): 229–243**. The classification and nomenclature of *Tephrosia* is reviewed and the names *Brissonia* Desv., *Tephrosia* section *Brissonia* DC. and *Tephrosia* section *Recueria* Benth. are lectotypified. An account of the species group surrounding *T. varians* is provided with description of the new species *T. delicatula* Pedley and *T. turpinii* Pedley.

Key Words: Leguminosae, Fabaceae, *Brissonia*, *Tephrosia*, *Tephrosia* section *Brissonia*, *Tephrosia* section *Recueria*, *Tephrosia delicatula*, *Tephrosia turpinii*, *Tephrosia varians*, Australia flora, Queensland flora, taxonomy, new species, identification key, distribution maps

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Introduction

Tephrosia Pers. is a 'taxonomically difficult' genus of an estimated 300 – 400 species (Lewis *et al.* 2005) distributed mainly in the tropics and subtropics of both the Old and New World. This figure could well be an underestimate; however, as studies of the genus in eastern Australia suggest that there are up to three times as many undescribed species as there are already described ones. This is the first of a series of papers that review the systematics of the genus over the eastern part of its range in Australia.

Classification & Nomenclature

Wood (1949) gave a clear account of the convoluted nomenclatural history of *Tephrosia*. In brief, the name is conserved with the previously published *Erebinthus* Mitch. (1769), *Needhamia* Scop. (1777) and *Reineria* Moench (1802) as *nomina rejecienda*. *Cracca* L. (1753) is also the same as *Tephrosia* but the name has been rejected in favour of *Cracca* Benth. (1853). This in turn, is also conserved but is now considered a synonym of *Coursetia* DC. (for example, by Estrada & Martinez 2003). Though *Tephrosia* was conserved at the International Botanical Congress of 1905 (*fide* Wood *op. cit.*), adherents of the 'American Code' continued to recognise *Cracca* L. until the 1930s. Conservation merely endorsed the decision of Candolle (1826) to adopt the name because Linnaeus applied the name *Cracca* in *Flora Zeylandica* (1747) differently from his use of it in *Species Plantarum* (1753). However, Weatherby (1935) opined that "neither *Tephrosia* nor *Cracca* L. ought ever to have been proposed". Today conservation of *Tephrosia* would certainly be accepted but probably not that of *Cracca* Benth.

Persoon (1807) accepted 39 species (two described for the first time) in *Tephrosia* but did not subdivide the genus in any way. Candolle (1826) had little doubt that the genus would have to be divided into several genera, but that in the state of knowledge at the time he believed it more prudent to erect simple sections[1]. Candolle (1825) had recognised

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1 'J'ai peu doute qu'il devra un jour être divisé en plusieurs genres; mais dans l'état actuel des connaissances, j'ai cru plus prudent d'en former de simple sections'.

74 species (18 of them with some doubt) distributed among four sections, namely: *Brissonia* DC., *Craccoïdes* DC., *Reineria* Moench and *Mundulea* DC. The type of the genus, *T. purpurea* (L.) Pers. (see Jarvis 2007), was referred by Candolle to section *Reineria*, which therefore becomes section *Tephrosia.*

Brissonia was published by Necker in *Elementa Botanica* (1790) as a "*species naturalis*". These were given unitary designations which resemble generic names, but are not to be treated as such. Necker's publication is listed in Appendix IV of the ICBN among *Opera unitqua appressa* and the name *Brissonia* is therefore not validly published. It was later validated as a generic name by Desvaux (1814). Though his name is illegitimate as he cited two generic names as synonyms, it does not prevent its use as a sectional name. Candolle used *Brissonia* as a sectional name, attributing it to Necker, but did not include in it any of the species of *Brissonia* Desv. He treated these among the 'Species non satis notae'. The sectional name *Brissonia* must therefore be attributed to him alone, not to (Desv.) DC. Lectotypification of the names *Brissonia* Desv. and *Tephrosia* section *Brissonia* DC. is essential if classifications of the genus after Candolle are discussed. Three of the species of sect. *Craccoïdes* are now referred to *Coursetia* DC., and the other to *Lotus* L. (*fide* Ottley 1944: 101).

Brissonia Desv., *J. Bot. (Desvaux)* 3: 78 (1814). **Lectotype** (chosen here): *Tephrosia coronillifolia* Desv., *loc. cit.*.

Tephrosia section *Brissonia* DC., *Prodr.* 2: 249 (1825). **Lectotype** (chosen here): *Tephrosia virginiana* (L.) Pers.

Meyer (1836) made a significant, perhaps undervalued, contribution to the classification of the genus. He described *Apodynomene* E.Mey., differing from *Tephrosia* in having ovate stipules similar to its spathaceous caducous bracts, and transverse seeds. In it he recognised two sections: *Epibrissonia* E.Mey. (three species) with barbate styles and *Epireineria* E.Mey. (one species) with glabrous styles. Harvey (1862) reduced the genus to sectional rank under *Tephrosia.*

Bentham (1859) placed South American species in two sections: *Brissonia* (three species) and *Recueria* sect. nov. (four species). They differed mainly in attributes of pods and calyces. Candolle (1825) had previously put two species of section *Recueria* in section *Reineria* (= section *Tephrosia*), and to endorse such placement section *Recueria* is lectotypified here.

Tephrosia section *Recueria* Benth., *Fl. Bras. (Martius)* 15(1): 47 (1859). **Lectotype** (chosen here): *Tephrosia leptostachya* DC.

T. leptostachya is sometimes considered to be conspecific with *T. purpurea*, the type of *Tephrosia*.

Later Bentham (1863) considered the genus as a whole. Since his classification greatly influenced subsequent workers, it deserves detailed examination. Probably following the principles set out by him and Hooker for the publication of *Genera Plantarum* (see Stevens 1996) he adopted a wide circumscription of the genus as he did for other large legume genera such as *Desmodium* Desv. and *Rhynchosia* Lour. He reviewed the classification, adding generic synonyms, and recognised three sections: (i) *Brissonia*, (ii) *Tephrosia* (as *Reineria*) and (iii) *Requienia* (described by Candolle as a distinct genus). He did not mention either section *Recueria* or section *Craccoïdes* and excluded section *Mundulea*, which he had raised, rather perfunctorily, possibly acting on a suggestion of Candolle (1826), to generic rank (Bentham 1852). The genera *Apodynomene*, *Macronyx* Dalziel and *Pogonostigma* Boiss. were discussed briefly but included in section *Tephrosia*, though he noted the first of these might be recognised as a subsection. As part of a large regional work, Bentham (1864) described 24 species all except one as new. The other, *T. purpurea*, was accepted with the addition of five varieties all confined to Australia. He referred all species "with the exception perhaps of *T. flammea* and *T. crocea* to section *Reineria*, with terminal or leaf-opposed racemes or axillary clustered pedicels, and to the large

subsection with subulate or small stipules, except *T. venulosa* [sic, perhaps a *lapsus calami* for *T. reticulata* Benth.] in which they are broad and striate but not so much so as in the S. African Apodynomenes".

J.G. Baker (1878) treated *Brissonia* as a subgenus, with *T. candida* DC. as sole species, as well as subgenus *Macronyx* (Dalziel) Baker (one species) and subgenus *Reineria* (DC.) Baker. In his diagnosis of section *Brissonia* Candolle (1825) had "Stylus lateriter barbatus" but referred *T. candida* to section *Mundulea* though noting in the description of the section that it was exceptional in having "stylus ... barbatus". He (Candolle 1826) discussed its position in the genus, although it is difficult to understand on what grounds his decision was made. Bentham had included *Macronyx* in section *Reineria*. E.G. Baker (1926) divided the genus into three: (i) *Eutephrosia* [= section *Tephrosia*], which included section *Brissonia* and section *Reineria*, (ii) *Pogonostigma* Boiss. (included by Bentham in section *Reinera*), and (iii) *Requienia*. The latter two contained two and one species respectively. The remaining 142 species were distributed among 42 series, none formally named.

Since Bentham and the Bakers many of the critical studies of the genus have been concentrated at herb. Kew with emphasis on the flora of the former British colonies in eastern and southern Africa. Notable exceptions are Domin (1926), Forbes (1948) and Wood (1949). Domin's contribution to the taxonomy of the Australian species is significant, though not a monograph as it was termed by Wood (1949). He recognised 22 species, one (*T. baueri* Benth.) included by Bentham under *T. purpurea*, two previously described by him (Domin 1912) and nine described as new, one of them (*T. affinis*) with an illegitimate name. He did not list 15 of the 23 species accepted by Bentham (1864). Forbes revised South African species of the genus. She described 67 species, more than a third of them for the first time, distributed among four unnamed sections. These sections seem aids to identification rather than groupings of taxonomically related species; for example, in its protologue *T. inandensis* H.M.L.Forbes was compared with *T. grandiflora*, which was placed in a different section. Wood (1949) published a comprehensive account of the "barbistyled" species of *Tephrosia* in north America. He noted that in his studies that the New World species fell "into two rather natural groups: those with glabrous styles and those with bearded or barbate styles".

In preliminary studies for the *Flora of Tropical East Africa*, Gillett (1958) also recognised that the genus included some species with glabrous styles and others with styles with indumentum of some sort ("barbistyled"). This is more or less in accord with distinctions between Candolle's sections *Reineria* and *Brissonia*. He also pointed out that *T. aurantiaca* Harms and a few allied species constituted a distinct group which might be considered outside the glabri-/barbistlyed division of the genus. The basis for this suggestion was *inter alia* the reticulation of the tertiary veins of the leaflets of the species. Wood (1949) had already emphasised the significance of both the indumentum of the style and the tertiary venation of the leaflets.

Brummitt (1980) took up Gillett's and presumably Wood's work and formally recognised *Tephrosia* subgenus *Barbistyla*, without referring either to section or subgenus *Brissonia*. He did not pursue Gillett's notes on *T. aurantiaca*, failing to mention the detailed discussion of the occurrence of pubescent styles among African species (Gillett 1959). Instead he concluded that "it seems best to refer the entire *T. aurantiaca* group, including *T. hockingii* subsp. *hirsutostyla* (Dewit) Gillett to the typical subgenus" and seems to have considered the venation of leaflets of little significance. He discussed the status of satellite genera, three of which had been described after the Bakers' treatments. Of these he maintained *Requienia* and *Ptycolobium* Harms as distinct but believed that *Caulocarpus* E.G.Baker and *Linophyllum* Hutch. were not different from *Tephrosia*. Bosman & de Haas (1983) rejected Brummitt's subgenera on the grounds of a lack of correlation between penicillate stigmas and indumentum of styles, and "furthermore it appeared to be impossible

to correlate the pubescence of the style with any other character, except that that the barbistyled species have larger flowers ...". Of the 20 species treated by them only the four introduced species are barbistyled. They foreshadowed the treatment of Geesink (1984) who admitted to only a limited knowledge of *Tephrosia*. He recognised all four genera discussed by Brummitt. Schrire (1987) supported Brummitt's division of the genus and added significantly to definitions of the subgenera. Brummitt (2007) presented a key to 70 species; species 1–30 were referred to subgenus *Tephrosia*, species 32–70 to subgenus *Barbistyla*. The affinities of species 31, *T. miranda* Brummitt (known from only two specimens), were considered obscure. It has unusual pods but he suggested it might be related to *T. zoutpansbergensis* Bremek. and *T. villosa* (L.) Pers. despite its pubescent style. Both Brummitt (2007) and Schrire (1987) placed *T. candida* in *T.* subgenus *Barbistlya*. Unless the subgenus is defined more narrowly to exclude *T. candida*, it should be referred to *T.* subgenus *Brissonia* (DC.) Baker.

The position of *Mundulea* (DC.) Benth. vis-à-vis *Tephrosia* and *Millettia* Wight & Arn. has been disputed. Geesink (1984) noted it to be scarcely distinct from *Millettia*. Schrire (1990) when discussing *Tephrosia pondoensis* (Codd) Schrire noted the differences between *Tephrosia* and *Mundulea*. He more or less dismissed the diagnostic value of attributes of leaf venation and dehiscence of pods, but stated that floral characters have proved more consistent in separating the two. Later some species of *Mundulea* were referred to the newly described *Pyranthus* Du Puy & Labat and *Sylvichadsia* Labat & Du Puy by Du Puy & Labat (1995) and Labat & Du Puy (1998) respectively. Both genera appear to be more closely related to another Madagascan genus *Chadsia* Bojer than to either *Tephrosia* or *Millettia*. Du Puy & Labat (2002) treated *Mundulea* as a distinct genus, but combined the key to its species with the key to those of *Tephrosia*; mainly because, contrary to the opinion of Schrire, attributes of their pods provided the most reliable differential characters and pods were often not available. Verdcourt (2007) iterated Bentham (1863) in noting that *Mundulea* "links *Tephrosia* with *Millettia*, but to combine it with either would lead to problems of definition. Certainly the three cannot be united, but *Mundulea* could perhaps be considered a subgenus of *Tephrosia*". I have examined only a few specimens of *M. sericea* (Willd.) A.Chev. the most widespread species of the genus; its calyx lobes are unlike those of any other species, African, Asian, north American or Australian I have seen but its general facies would place it in *Tephrosia*. Its dilated staminal filaments seem a minor attribute in distinguishing genera.

Differing opinions on the circumscription and status of *Tephrosia* subgenus *Barbistyla* seem to have inhibited the evaluation of characters other than stylar indumentum that might be significant for the classification of *Tephrosia* as a whole. Many workers have commented on the venation (or nervature) of the leaflets that they considered characteristic of the genus. For example, Forbes (1948): "There is one constant and conspicuous character by which the genus maybe readily recognised, the close distinct penninerved venation of the leaflets"; Bosman & de Haas (1983): "The intersecondary nerves are relatively numerous, parallel, rather straight (never S-shaped) and curved slightly upwards to the margin in which they usually end"; Geesink (1984): "the nerves are straight, forming a sharp angle (usually 10°–30°) with the midrib". Wood (1949: 210) and Gillett (1958) recognised minor variants of this pattern; Wood: "More or less parallel lateral veins are given off obliquely from the midrib of the leaflet in all species. The areoles formed by the veinlets between these veins are,... either elongate or isodiametric"; Gillett: "*T. aurantiaca* s. lat. is undoubtedly a very natural group, distinguished by ... rather large leaflets... with rather wide spaces between the chief lateral nerves and a very prominent network of venules connecting them". Rudd (1991), in a key to genera distinguished *Tephrosia* from *Mundulea* and *Millettia* by its "numerous straight, closely parallel lateral veins mostly extending to the margin".

Cowie (2004) drew attention to the differences and diversity of Australian species. In defining four groups of Australian species differing in their venation patterns, he upset established views. His first group, with *T. phaeosperma* F.Muell. ex Benth. as an example, corresponds to the accepted 'typical' pattern ; the second and third are difficult to place; the fourth is distinctive. It consists of "species with well spaced secondary veins curving or dichotomising before the margin, the intersecondary venation often closely reticulate, prominent or not". Bentham (1864) seems to have recognised this group indirectly where, in his key to species, the first five have "veins anastomosing or reticulate within the margin". It possibly requires the recognition of a genus distinct from *Tephrosia* and studies of Queensland species have strengthened my opinion that this is warranted.

Since *Tephrosia reticulata* Benth. and related species in the Northern Territory require further study, which I cannot undertake, I have retained the three reticulately veined species treated below in *Tephrosia*. In the protologue of *T. oxalidea* R.Butcher & P.J.H.Hurter, Butcher & Hurter (2012) provided detailed description of the venation of a reticulately veined species. Their somewhat diagrammatic illustrations of leaflets of *T. coriacea* Benth. (Fig. 1A) and *T. rosea* F.Muell. ex Benth. (Fig. 1D) contrast the reticulate venation of the former with the 'typical' venation of the latter.

In the relaxed atmosphere of the final session of the 16th Botanical Congress in St Louis in 1999, I suggested to some friends from herb. Kew that about 12 Australian species from northern Australia characterised by leaves with reticulate veins might be segregated as a separate genus (quoted in Lewis *et al.* 2005).

Except for indumentum of the style, attributes of inflorescences and flowers have been used in only a rather indefinite way to delimit infrageneric taxa in *Tephrosia*. Limited study of living and herbarium specimens; however, suggests that *Apodynomene* might be recognised as a distinct genus. In practice it has been treated as a coherent group of species by a succession of authors. Forbes (1948) placed most of the species in her 'section 4', a notable exception being *T. inandensis* in 'section 3', though, in its protologue, she compared it with *T. grandiflora* (L'Her. ex Ait.) Pers. (section 4), a species that is naturalised in the West Indies. Wood (1949: 374) noted that it is easily recognised: "The large, promptly deciduous bracts and broad stipules were largely the basis of the segregate genus *Apodynomene* E.Mey., of which this is the type-species. Although stipules and bracts of this type characterize a group of South African species, the absence of secondary bracts is indeed anomalous, there seem to be no real reasons for separating this group as a distinct genus". He considered Harvey's (1862) treatment of the group as a section might prove to be a more reasonable disposition. It should be noted that Wood effectively selected *T. grandiflora* as generitype of *Apodynomene*. Schrire (1987) in his notes on *T.* subgenus *Barbistyla*, commented: "within the subgenus *Barbistyla*, inflorescence characters (bracts) and fruit characters (pod size and seed position) separate the *T. grandiflora* allies from those of *T. longipes* [the type of the name *T.* subg. *Barbistyla*]. Inflorescence specialisation has been particularly marked in the *T. grandiflora* alliance". He keyed 11 species of this alliance more or less together (species No. 11–21) though he did not use absence of secondary bracts as a key character.

It might be expected that molecular analysis could suggest a plausible scheme for generic and infrageneric classification of *Tephrosia* and its allies. LPWG (2013) gave a comprehensive account of the advances and deficiencies in the 'building a high-resolution molecular phylogeny of legumes'. For an antipodean taxonomist it was not at all encouraging. Among the desiderata was "we must prioritise species-level phylogenetic investigations of known non-phylogenetic genera". How is one to know whether *Tephrosia* is phylogenetic or not? In the phylogram of Kajita *et al.* (2001) *T. heckmanniana* Harms and *T. grandiflora* formed a clade sister to one consisting of *Mundulea sericea* and *Chadsia versicolor* Bojer. da Silva *et al.* (2012), in a

study concentrated on *Lonchocarpus* Bojer, confirmed the monophyly of *Tephrosia*, presumably using Candolle's (1825) or Bentham's (1863) classification. Seven species were used in the study (not all shown in the published phylogram), all with 'typical' venation. A detailed molecular analysis of the genus, including species with 'atypical' venation, and purportedly related genera is necessary.

I have no doubt that Candolle (1826) was correct in his assessment that one day *Tephrosia* will need to be divided into several genera, but also agree with Cowie (2004) that "there is a need for further investigation of generic limits and infrageneric subdivisions".

Materials and methods

The species treated here are characterised by the reticulate venation of their leaflets. They fall into the fourth group of species defined by Cowie (2004) though the secondary and tertiary veins of their leaflets are more prominent than those of the species described by him. Only one of them (*T. gyropoda* Cowie) occurs in Queensland, near the Northern Territory border, some 600 km west of the nearest collecting locality of any of the other three species covered here. To some extent it resembles *T. delicatula*, but differs in the often cuneate bases of its leaflets which are sparsely pubescent on both surfaces and, above all, by its arillate seeds.

In this and future papers in the series, only the primary bract (the one subtending a fascicle of flowers in inflorescences) is described. Secondary bracts occur at the base of each flower of fascicles of all species examined, though sometimes they are early deciduous. Inflorescences of the type found in *Apodynomene* seem not to occur.

In all descriptions some modifications of customary terms have been adopted. Describing the architecture of leaves I have followed the terminology of Butcher & Hurter (2012, see particularly their fig. 1) with the addition of the term 'leaf axis', which denotes the length of petiole + rachis. Length of the leaf axis in descriptions removes uncertainty as to whether or not 'leaf-length' includes the length of the terminal leaflet. It does not. The calyx is 5-lobed, the lobes usually unequal, the upper pair (vexillary) united to some extent, the lowermost (carinal) often longer than the others. In most Australian species the calyx is therefore distinctly bilabiate. I have considered the two vexillary lobes as one, divided to some degree. The rather indefinite terms 'notched', 'split' and 'divided' are used to note the type of division. I have introduced the term 'knob' to describe the protuberances that usually occur on the basal part of the staminal sheath and adjacent part of the basally free anther-filament. These are sometimes called calluses or callosities but I have restricted the term callus (*pl.* calli) to the thickening of the basal part of the standard. The calli and knobs probably determine the attitude of the flower at anthesis and have rôles in its pollination.

Taxonomy

Key to species allied to *Tephrosia varians* from eastern Queensland

1 Leaves with (9–)11–15 leaflets, each (12–)16–24 mm × 8–12(–14) mm, (1–)1.5–2.2 times longer than wide; pedicels 10–16 mm long; flowers 8–10 mm long, apricot-orange; keel petals glabrous . . . . . **T. delicatula**

1. Leaves with (3–)5–7(–9) leaflets, each 25–60 mm × 6–25 mm, 1.3–4(–7) times longer than wide; pedicels 3–15 mm long; flowers 8–20 mm long, orange or yellow; keel petals pubescent or glabrous (or a few hairs on lower margin) **2**

2 Flowers yellow, 8–11 mm long; keel petals with loosely appressed hairs on lower margins or in proximal or distal half of lamina; pedicels 3–6 mm long; pods 4–6 mm wide. . . . . **T. varians**

2. Flowers apricot or orange, 15–20 mm long; keel petals glabrous or with a few appressed hairs on lower margins; pedicels 5–15 mm long; pods 6–10 mm wide. . . . . **T. turpinii**

Tephrosia varians (F.M.Bailey) C.T.White, *Proc. Roy. Soc. Queensland* 53: 214 (1942); *Galactia varians* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 10: 22 (1895); *Queensl. Fl.* 2: 430, t. 14 (1900). **Type:** Queensland. Cook District: Coolgarra [17°34′S 145°12′E], April 1895, *M.Butler s.n.* (holo: BRI [AQ22860]).

Tephrosia lutea F.Muell., *Fragm.* 5: 9 (1865) *nom. invalidum* & 9: 64 (1875) *pro syn.*

Sprawling (sub)shrub to *c.* 40 cm tall: annual stems from perennial carrot-like taproot. Branchlets at base of plant terete often with scattered ± spreading hairs to 0.5 mm long, becoming fluted, glabrous in upper part; stipules linear to narrow-triangular, indurated, 3–6 mm long, 1–8 veins depending on width; young growth bronzed. Leaves with 5–7(–9) leaflets; axis 70–90(–140) mm long, petiole 3–7.5(–9) cm long, interjugal rachis 15–30(–38) mm long, ultrajugal rachis (5–)10–25(–28) mm long; leaflets somewhat discolorous, oblong, ovate, occasionally obovate, (25–)30–60(–70) mm long, 6–25(–40) mm, rarely more, wide, 1.3–4 times longer than wide, rounded, sometimes truncate or emarginate at tip, cordate or occasionally rounded at base, glabrous except rarely a few hairs on margins or along midrib beneath; petiolules glabrous or with a few hairs, 1–2 mm long. Inflorescence terminal or leaf-opposed, 30–50 cm or more long, sparsely flowered in distal half; fascicles of 2 or 3 flowers, usually with an additional bud; subtending bract, to 2 mm long deciduous when only about as long as developing fascicles; pedicels 3–6 mm long, glabrous or sparsely appressed pubescent. Flowers 8–11 mm long, yellow, occasionally with red suffusion at base of standard; calyx glabrous to moderately dense pubescent, hairs short, appressed; tube 2–2.5 mm long, upper lobe wide-triangular or rarely rounded, 0.8–1.5 mm long, notched 0.1–0.3 mm, lateral lobes triangular 1–2(–2.4) mm long, sometimes curved when long, lower usually longer than laterals 1–2.3(–3.2) mm long, sometimes acuminate. Corolla: standard concave, hemispherical or reniform, emarginate, 5–8 mm long, 7–12 mm wide, usually with small thick prominent calli, claw (1–)2–2.5 mm long; wing petals longer than keel, often markedly so, 5.5–8.5 mm long, (2.5–)3–5 mm wide, auriculate, claw 2.2–3(–3.5) mm long; keel 4–5(–6) mm long, 2–2.7(–3) mm wide, pubescent with loosely appressed hairs along lower margin or in proximal half, claw 2–2.5(–3) mm long. Staminal sheath glabrous, knobs absent or poorly developed, anthers 0.4–0.6(–0.8) mm long; ovary pubescent with usually sparse appressed hairs, style flat and glabrous, geniculate at tip (*secus* Lee 1948), stigmatic surface inside. Pods oblong, flat, straight or slightly decurved, 45–60 mm long, 4–6 mm wide; valves cartilaginous, glabrous or sparsely appressed pubescent, up to 10–12 seeds, *c.* 4 mm between their centres, spongy tissue between them. Seeds (few seen mature) spherical, olive-brown, 3.6–3.8 mm diam.; small rim aril. **Fig. 1**.

***Additional selected specimens* (all BRI):** Queensland. Cook District: Cairns, Dec 1941, *Blake 14508*; *c.* 5 km SSW of Beagle North Camp, *c.* 3.7 km SSW of Weipa, Dec 1981, *Clarkson 4177*; 2 km S of the Big Coleman River on the Coen to Musgrave Road, May 1987, *Clarkson 7118 & Simon*; 30 km N of Wenlock River crossing on Peninsula Development Road, Aug 1987, *Clarkson 7326*; 10 km S of Wenlock River on Peninsula Development Road, Apr 1990, *Clarkson 8503 & Neldner*; 7 miles [11 km] N of Moreton Telegraph Station, Jul 1968, *Gittins 1826*; Whitewater Station, near boundary of Undara NP, Dec 2004, *McDonald KRM3230*; Undara NP, E of Mount Surprise, Jan 2005, *McDonald KRM3314*; Undara NP, E of Barkers Knob, Dec 2005, *McDonald KRM4684*; junction of Herberton – Petford – Irvinebank Roads, Feb 2006, *McDonald KRM4485*; 17.2 km W of Irvinebank, Mar 2007, *McDonald KRM6176*; near Emu Creek Station, 4.1 km E of road bridge, Jan 2008, *McDonald KRM7118*; SE of Mareeba, Jan 1982, *Pedley 4828* (+K, MEL); *c.* 28 km SSE of Laura, Jun 2006, *Wannan 4684 & Ray*; E of Musgrave on road to Marina Plains Station, Mar 2007, *Wannan* 4684 & *Beasley*. North Kennedy District: *c.* 0.5 km E of Button Rock, Mount Zero

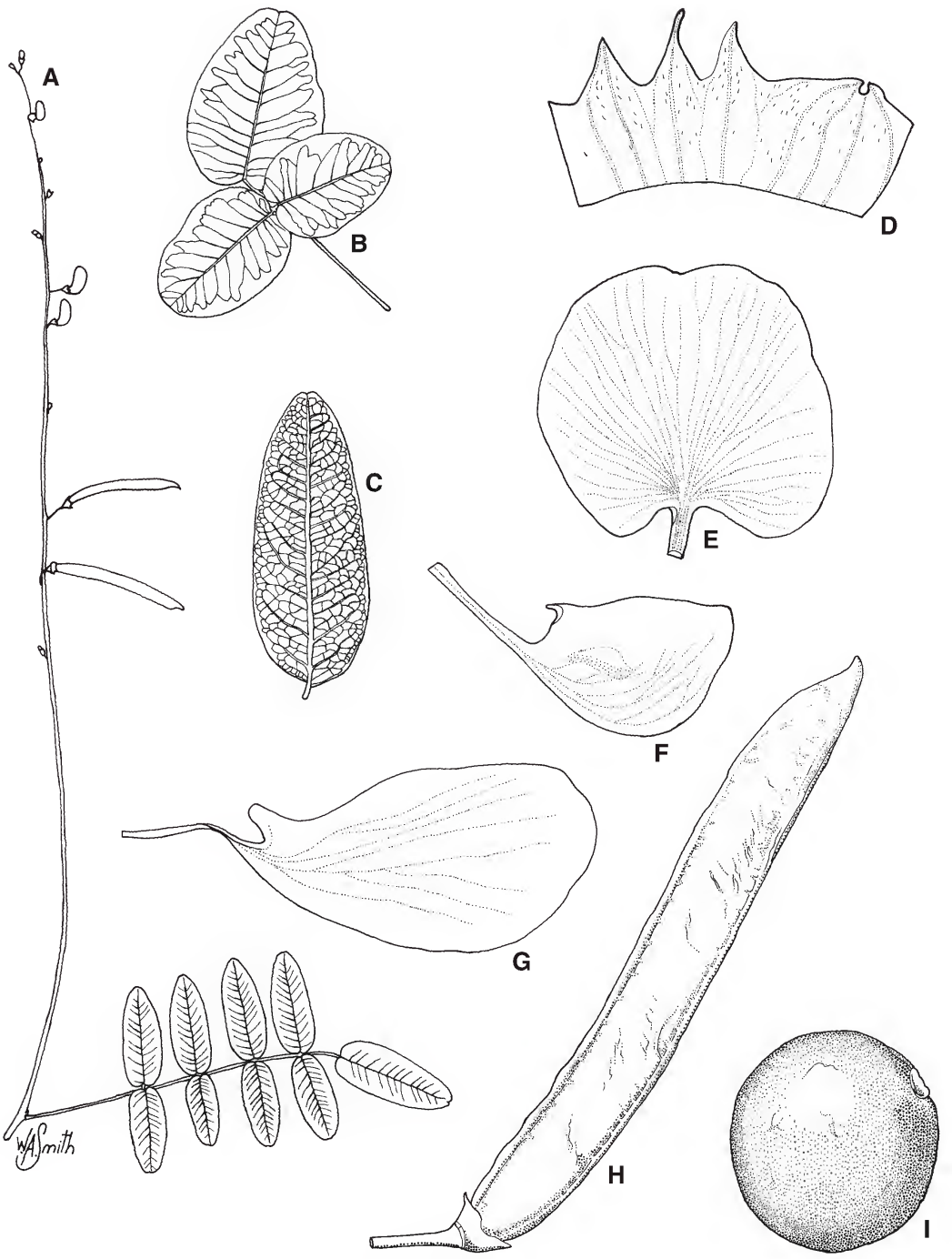

Fig. 1. ***Tephrosia varians***. A. twig with inflorescence ×0.4. B. trifoliolate leaf (leaflets unusually large) ×0.4. C. leaflet, showing venation ×1. D. calyx, outer surface ×6. E. standard ×4. F. keel petal ×6. G. wing petal ×6. H. pod (slightly immature) ×2. I. seed ×8. A from *McDonald KRM4685* (BRI); B from *McDonald KRM10308* (BRI); C–H from *McDonald KRM8682* (BRI); I from *Wannan 4449* (BRI). Del. W. Smith.

property, *c.* 80 km W of Townsville, Jan 2007, *Cumming 24593*; Stuarts River [near Townsville], in 1891, *Johnson s.n.* (+MEL 582909 & 582910); Herberton, Jan 1912, *Kenny s.n.* (AQ238666); Stuart, near Townsville, Nov 1940, *Watts s.n.* (AQ238661).

***Distribution and habitat*:** The species ranges from the northern part of Cape York Peninsula to about Townsville and inland to about Kidston (19°S, 144°E) (**Map 1**). It occurs in eucalypt woodland on well drained soils, mainly granitic sands in the south and red earths in the north.

***Notes*:** One specimen (*Clarkson 8503 & Neldner*) from south of the Wenlock River on the Peninsula Development Road and about 20 km from the collecting locality of *Gittins 1826* (cited above) is unusual. It is unifoliolate with longer petiolules and has shorter pods with more crowded seeds.

Mueller (1865) distinguished a species, evidently close to *Tephrosia reticulata* Benth, from the shores of Rockingham Bay. He stated that, if it differed, except for its 'perfect glabrosity' [my translation of the Latin], was to be called *T. lutea*. The name is not validly published as it is clearly a provisional one. Later (1875) he referred the species to *T. reticulata*.

Tephrosia turpinii Pedley, **sp. nov.** affinis *T. varianti* a qua floribus grandioribus aurantiis vel armeniacis non luteis petalis carinae plerumque glabris vel interdum pilis paucis secus marginem inferum praeditis et leguminibus latioribus paucioriseminalibus differt. **Typus:** Queensland. Cook District: near Emu Creek Station, 4.1 km by road E of Emu Creek bridge, 11 January 2008, *K.R. McDonald KRM7119 & A. Ford* (holo: BRI; iso: DNA).

Tephrosia sp. (Petford J.R. Clarkson 2774A); Holland & Pedley in Bostock & Holland (2010).

Similar in size and habit to *T. varians*. Young stems slightly angular becoming terete, indumentum of sparse appressed hairs 0.1–0.3 mm long, glabrescent; stipules linear to triangular, 3–6 mm long with up to 5 veins when wide. Leaves of (3–)5–7 leaflets, rarely extremely minutely stipellate; axis (5.5–)7–12.5(–14) cm long, petiole 3–7(–8) cm long, interjugal rachis 15–35(–45) mm long, ultrajugal rachis 4–20 mm long, rarely terminal leaflets digitate; leaflets slightly discolorous, oblong, elliptic or ovate, 25–55(–65) mm long, 8–22(–25) mm wide, (1.3–)2–3.5(–4) times longer than wide, rounded or somewhat truncate at tip, minutely mucronulate, rounded, often slightly emarginate or subcordate at base, glabrous above, glabrous or with extremely sparse short hairs beneath, petiolules 1–2 mm long. Inflorescence terminal or leaf opposed, 10–25(–35) cm long, open; fascicles of 2 or 3 flowers, subtending bract ovate, deciduous when *c.* 1 mm long, pedicel 5–15 mm long, sparse to dense appressed hairs. Flower 15–20 mm long, apricot or orange; calyx sparse to moderately dense appressed hairs; tube (2.2–)2.5 mm long, upper lobe wide triangular (1.5–)2–3 mm long, usually notched 0.3–0.7 mm, occasionally sinus between lobes wide, lateral lobes (1.5–)2–3 mm long, lower usually longer, (1.5–)2–4.5 mm long, all tending to be acuminate when long. Corolla: standard broadly transversely obovate or ± circular, (9–)11–16 mm long, (11–)12.5–16(–20) mm wide, thickened at base or with small thick calli, claw 2–3(–4) mm long; wing petals as long as or slightly longer than keel, (8–)12–15 mm long, 4.5–7.5 mm wide, not or only slightly auriculate, claw 2–3.5 mm wide; keel petals 8–12 mm long, 4–5(–6) mm wide, glabrous or occasionally sparse appressed hairs on lower margin; staminal sheath glabrous, knobs absent or poorly developed, anthers 0.8–1(–1.2) mm long. Ovary with dense appressed hairs; style glabrous, geniculate at tip, stigmatic surface inside angle occasionally with a few short hairs. Pods flat, straight, oblong, (40–)55–60 mm long, 6–10 mm wide, with up to 6 or 7 seeds, (4–)5.5–7 mm between their centres with spongy tissue between them; valves coriaceous, glabrous or with a few scattered short appressed hairs. Seeds flat, oblong in outline, 4.5–5 × 4–4.5 mm, small rim aril. **Fig. 2**.

***Additional selected specimens* (all BRI): Queensland.** Cook District: 16 km W of North Kennedy River on road from Fairview to Kimba Station, Dec 1981, *Clarkson 4205*; Burke Development Road, *c.* 11 km W of Petford, Feb 1981, *Clarkson 2774A*; Morgan's Folly,

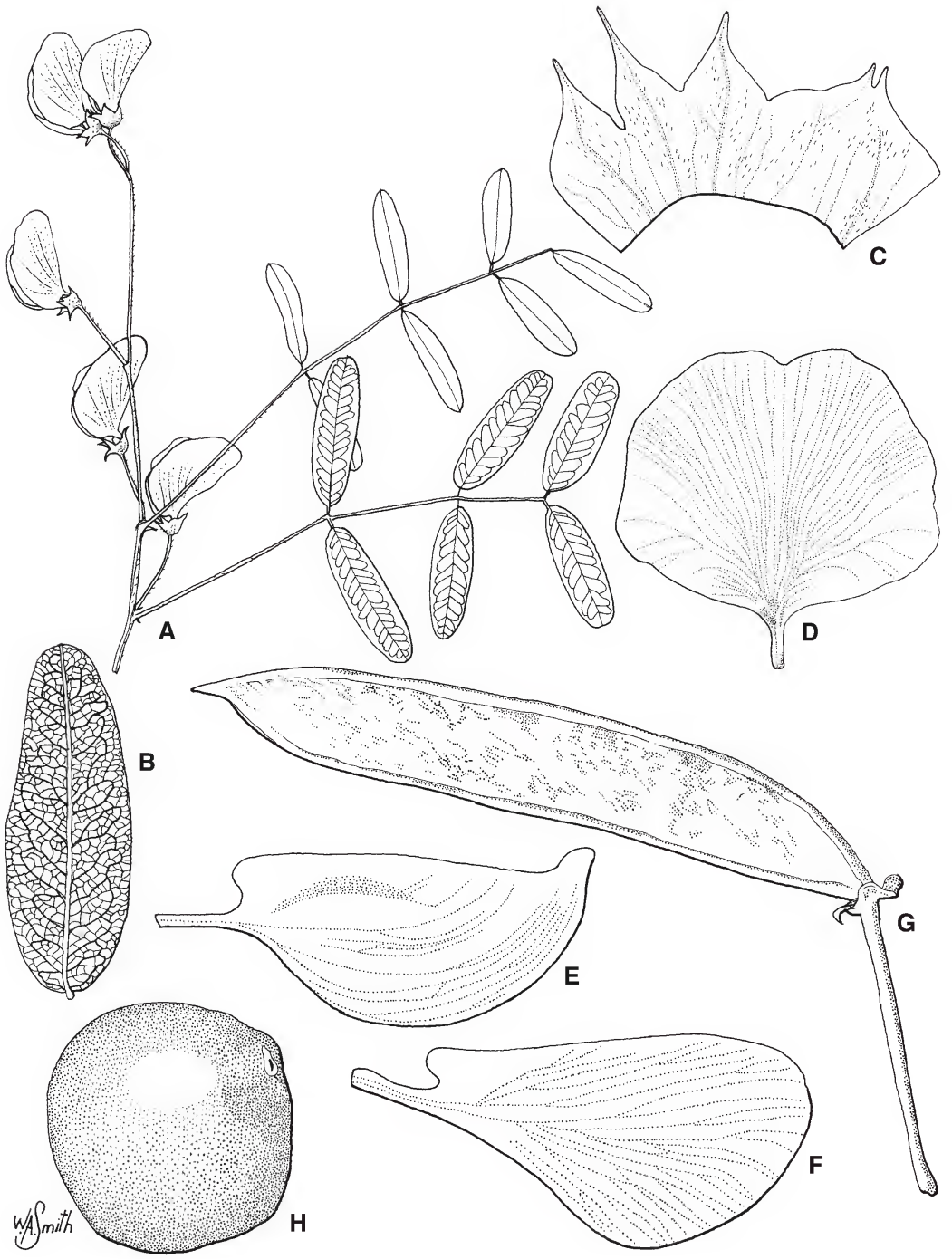

Fig. 2. ***Tephrosia turpinii***. A. twig with inflorescence ×0.8. B. leaflet, showing venation ×1. C. calyx, outer surface ×4. D. standard ×3. E. keel petal ×4. F. wing petal ×4. G. pod (slightly immature) ×2. H. seed ×8. A from *Wannan 1945* (BRI); B from *McDonald KRM7119* (BRI); C–F from *Ford AF2498* (BRI); G from *McDonald KRM3257* (BRI); H from *Wannan 5259* (BRI). Del. W. Smith.

38 km along road to Blackdown Station, off Chillagoe to Wrotham Park road, Feb 1994, *Forster PIF14754* (+DNA); Chillagoe, Jan 1931, *Hubbard & Winders 6759* (+K; cited by White (1942) as *T. varians*); Emu Creek Station between Emu Creek and Walsh River, Nov 2005, *McDonald KRM4614 et al.* (+DNA, NSW); 3.7 km by road W of Almaden, Dec 2005, *McDonald KRM4649* (+MEL); 64.4 km N of Laura near Weiss Creek, Nov 2010, *McDonald KRM10086* (+DNA, MEL); Lappa, Jan1982, *Pedley 4838A*; DPI experimental area, Kalinga Station, Jan 1976, *Staples IBS2241* (distributed as *T. varians*); Tate River, Feb 1938, *Straughan s.n.* [AQ238667]; cited by White (1942) as *T. varians*).

***Distribution and habitat*:** *Tephrosia turpinii* ranges from the northern part of Cape York Peninsula to 18°S latitude a little west of the Great Dividing Range (**Map 1**). Unlike *T. varians* it has not been collected in the Townsville area. It occurs in similar habitats to those of *T. varians*; that is: in eucalypt woodland on well drained soils mainly on granitic sands in the south and red earths in the north. The two species occasionally grow together.

***Etymology*:** The species is named for my friend and colleague Mr G.P. ('Gerry') Turpin, an elder of the Mbabarum people whose land includes that part of the distribution range where the species commonly occurs.

Tephrosia delicatula Pedley, **sp. nov.** affinis *T. varianti* a qua foliis foliolis pluribus minoribus petiolulis longioribus praeditis pedicellis longioribus floribus grandioribus aurantiacis non luteis carinae petalis ±glabris leguminibus longioribus angustoribusque differt. **Typus:** Queensland. Cook District: 6.8 km along Battle Camp Road from West McIvor Road junction, 8 January 2008, *K.R. McDonald KRM7106* (holo: BRI; iso: CNS, DNA, K, MEL *distribuendi*).

Twiggy multistemmed shrub to 50 cm tall, annual stems from perennial parsnip-like taproot; young stems reddish, terete, glabrous; young growth bronzed; stipules linear subulate to *c.* 6 mm long. Leaves with (9–)11–15 leaflets; axis 90–125 mm long, petiole 15–30(–35) mm long, interjugal rachis (8–)12–15(–18) mm long, ultrajugal rachis (2–)5–10 mm long; leaflets oblong elliptic or somewhat obovate, the terminal tending to be smaller than the laterals, (12–)16–24 mm long, 8–12(–14) mm wide, (1–)1.5–2.2(–2.4) times longer than wide, rounded, minutely mucronulate at tip, obtuse at base, slightly discolorous, glabrous or with a few scattered appressed hairs beneath, veins raised on both surfaces; secondary veins 8–15 on each side of midrib; petiolules 2–3 mm long. Inflorescence terminal, to *c.* 30 cm long, fascicles sparsely arranged in distal half, occasionally a fascicle in axil of subtending leaf; fascicle 3-flowered, subtending bract deciduous well before anthesis, 0.5–2 mm long, pedicel 10–16 mm long, glabrous or with scattered appressed hairs. Flowers 8–10 mm long, apricot-orange; calyx with sparse short appressed hairs, tube 2–2.5 mm long, upper lobe obtuse or occasionally acuminate, 1–1.6 mm long, notched for *c.* 0.2 mm, lateral lobes and lower lobe triangular, occasionally acuminate, laterals 1–1.6 mm long, lower 1.5–3 mm. Corolla: standard ± square, emarginate, 7–10 mm long, 10–11 mm wide, only thickened at base or calli well defined, claw wide, 1–1.3 mm long; wing petals longer and wider than keel, 7.5–9 mm long, 3.5–4.5 mm wide, shortly auriculate, claw 2–3 mm long; keel petals 5–6 mm long, 2.8–3.5 mm wide, glabrous, claw 2–3 mm long. Staminal sheath glabrous, knobs moderately developed, anthers 0.5–0.6 mm long. Ovary with dense appressed hairs; style flat and glabrous, geniculate at tip with stigmatic surface in angle. Pods (dehisced) straight, sparse appressed hairs, *c.* 50 mm long, 3–3.5 mm wide. Seeds spherical or almost so (only 3 seen mature), pale khaki in colour, 3.3–3.4 × 2.5–3.3 mm. **Fig. 3**.

***Additional specimens examined* (all BRI, duplicates to be distributed as indicated):** Queensland. Cook District: Battle Camp Road, Jan 2008, *McDonald KRM7112* (CANB, DNA, K, MEL, NSW), Apr 2008, *McDonald KRM7219 & Covacevich.*

***Distribution and habitat*:** *Tephrosia delicatula* is quite common in the vicinity of the type locality some 35 km NW of Cooktown (**Map 1**), where it is found in eucalypt woodland dominated by *Eucalyptus phoenicea* F.Muell.or *E. tetrodonta* F.Muell. and *Corymbia nesophila* (Blakely) K.D.Hill & L.A.S.Johnson on shallow soil on low sandstone hills.

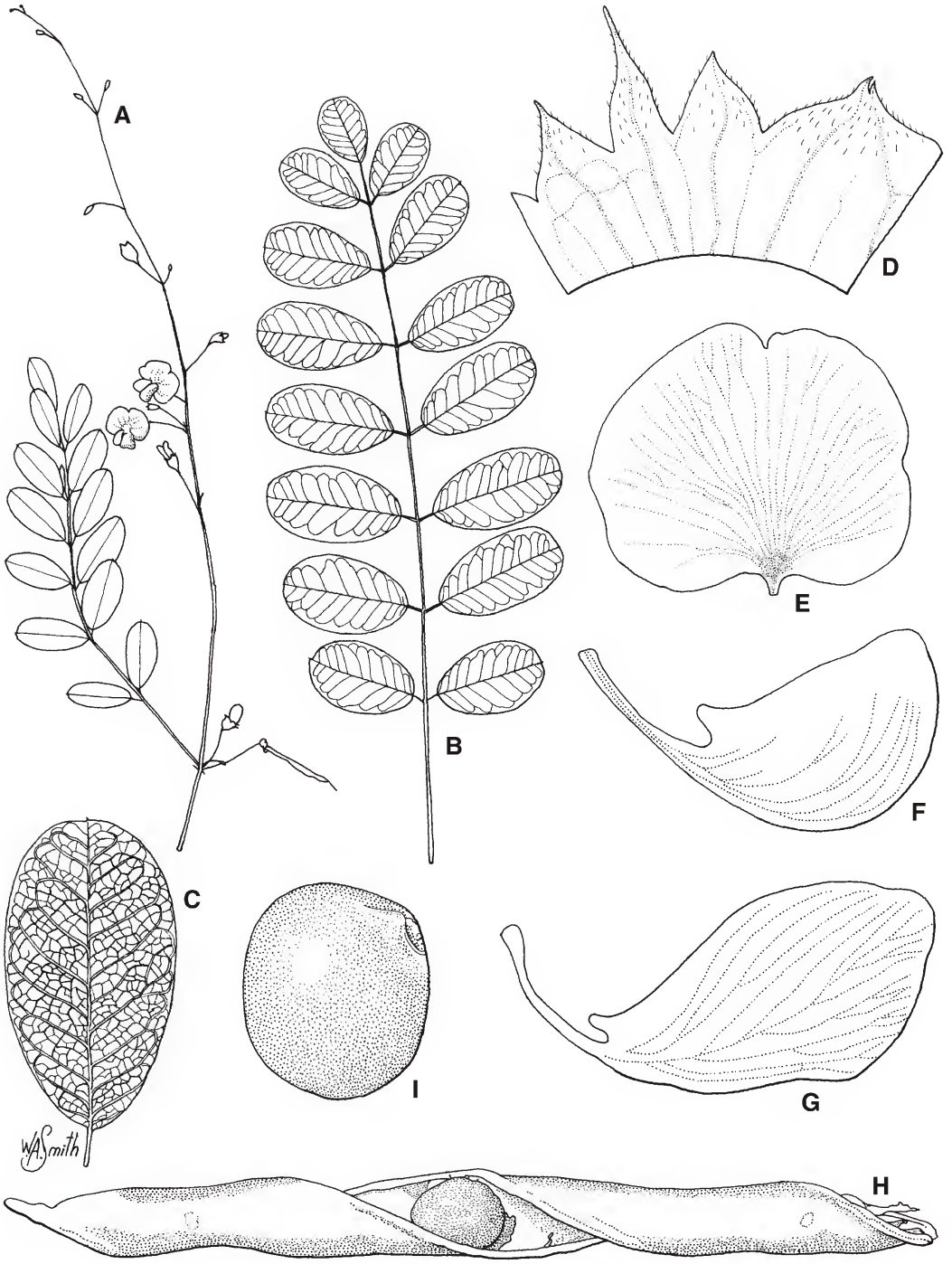

Fig. 3. ***Tephrosia delicatula***. A. twig with inflorescence ×0.5. B. leaf ×0.8. C. leaflet, showing venation ×2. D. calyx, outer surface ×6. E. standard ×4. F. keel petal ×6. G. wing petal ×6. H. pod ×2. I. seed ×8. A, D–G from *McDonald KRM7106* (BRI); B & C from *McDonald KRM7112* (BRI); H & I from *McDonald KRM7219* (BRI). Del. W. Smith.

***Notes*:** A specimen (*Bean 5564 & Forster* [BRI]) collected some 10 km west of the type locality and another (*S.L.Thompson ST13056* [BRI]), *c.* 240 km west of it, possibly represent hybrids with *Tephrosia varians* or *T. turpinii*. They have lanceolate leaflets longer than those of *T. delicatula* though their venation patterns are similar.

***Etymology*:** The specific epithet is from the Latin *delicata* and *-ula* and alludes to the smaller leaflets with finer venation when compared to those of both *T. varians* and *T. turpinii*.

Acknowledgements

I wish to thank W. Smith for preparing the figures and map. Over a long period of time I've been able to access herbarium collections both in Australia and overseas, particularly at Kew; and I wish to thank the relevant staff for this.

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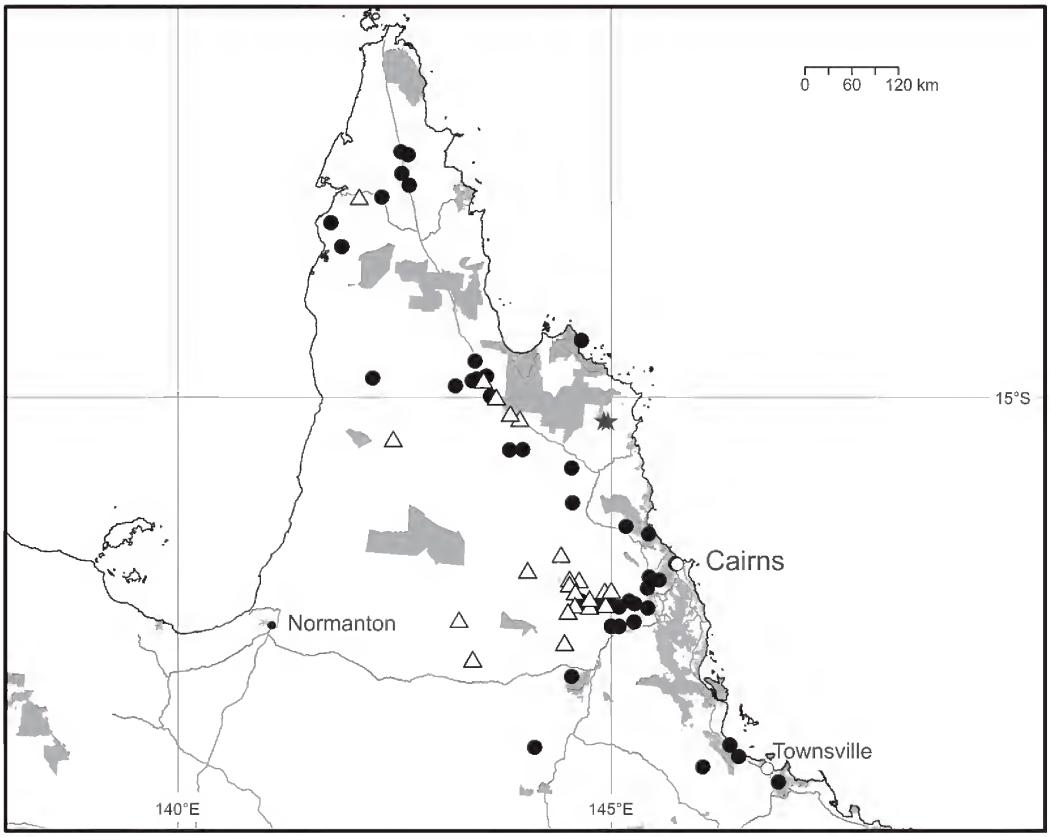

Map 1. Distribution of *Tephrosia delicatula* ★, *T. turpinii* △ and *T. varians* ●. N.B. specimens discussed under the Notes Section for *T. delicatula* are not mapped.

C.T. White's botanical survey and collections from Papua in 1918

A.R. Bean

Summary

Bean, A.R. (2014). C.T. White's botanical survey and collections from Papua in 1918. ***Austrobaileya* 9(2): 244–262**. In July and August 1918, Cyril Tenison White spent four and a half weeks in Papua New Guinea, during which time he went on two extended excursions and collected 829 botanical specimens, of which at least 722 are known to be extant, representing 562 species. 32 new species and two new varieties were named from specimens collected by White during his survey, including 15 new taxa authored or co-authored by White. This paper provides an itinerary for his time in Papua, accurate geocodes for his collections, and descriptive and photographic background for his excursions. The significance and legacy of White's Papuan survey are discussed.

Key Words: historical botany, history, C.T. White, Brisbane, Papua, Papua New Guinea, herbarium specimens

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Introduction

Cyril Tenison White (1890–1950) was the grandson of the very well known Queensland Colonial Botanist, F.M. Bailey, and it was from him that he learnt his botanical skills. Upon the resignation of his uncle, J.F. Bailey from the position of Government Botanist, the position was given to C.T. White, initially in an acting capacity, but formalised in November 1917[1]. He was just 27 years old. He had apparently been offered 'an important scientific post in the Pacific' just prior to his permanent appointment as Government Botanist[2]. Judging by his correspondence and other archived material, he was an enthusiastic and hard-working man, and even in the early stages of his career, an accomplished taxonomist and collector (**Fig. 1**).

This paper provides a detailed examination of C.T. White's pioneering botanical survey and collections in southern Papua New Guinea (then known as the Territory of Papua) in July and August 1918. The aims are to determine accurate dates and geocodes for the places visited by White; to provide descriptive background for his excursions, and to analyse the plant collections he made.

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Fig. 1. C.T. White, *c.* 1915[3]

Materials and methods

The Queensland Herbarium specimen database (Herbrecs) was used to generate a spreadsheet of White's 1918 collections in

Papua. The author has located all of those specimens, now contained in the collection at BRI, to assess their quality, to check for the presence of a field label, and to uncover any information not recorded on the database. Details of specimens not at BRI were extracted from White (1922) and other publications of the time, and from communication with other herbaria, namely A, FI and NSW. The 'Trove' website (National Library of Australia 2009-onwards) has been extensively used, to elucidate travel dates from Brisbane to Papua and back, and for descriptive articles published in newspapers of the time. A few letters from the Queensland Herbarium archives have shed light on some aspects of the trip, and visits to the National Archives (Brisbane office) and the University of Queensland (Fryer Library) provided further details.

Some notes supplied by White (1922) on floristics and vegetation are quoted here, and these are supplemented with text and photographs by other people who travelled in Papua around the same period.

The latitudes and longitudes for the various locations cited by White have been determined using both contemporary maps (e.g. O'Malley & Stanley 1916) and modern sources (e.g. GeoNames website, Google Earth).

Herbarium acronyms (e.g. A, BRI) follow Thiers (continuously updated).

The journey from Australia

In June 1918, the Lieutenant Governor of Papua, Horace "Judge" Murray, invited White to visit Papua as his guest (White 1922). White must have jumped at the opportunity, as he arranged a visit for the following month. Murray and White left Brisbane together on the steamship 'Marsina'[4] on the 16th July 1918[5]. The 'Marsina' (**Fig. 2**) had left Sydney three days earlier[6] and was bound for Rabaul via Port Moresby[7]. Steamer passage from Brisbane to Port Moresby at that time took about seven days, and White and Murray probably arrived in Port Moresby during the night of the 22nd /23rd July.

White collected plants around Port Moresby for the first two days of his visit. He then went on two overland excursions, both times in company with Evan R. Stanley (1885–1924), the Government Geologist for Papua, who had been living and working in Papua since January 1911 (Davies 1987). No doubt Stanley organised the excursions and chose the routes.

The residents of Port Moresby were clearly underwhelmed by the visit of C.T. White. The local newspaper does not mention his name at any time during the visit – not even on the passenger list[8] for the ship that carried him to Port Moresby! Local residents returning from time in Australia were written up, mining engineers and businessmen were discussed at length, but a visiting botanist, it seems, was a non-event.

Port Moresby in 1918

World War I was still in progress, and every issue of 'The Papuan Courier' was full of war news from Europe, but life in Port Moresby was seemingly normal. Steam ships cruised around the western Pacific unimpeded and trade between Australia and Papua was vigorous and regular. There was a steady export of goods such as copra, rubber, coffee and sisal hemp[9], and economic development in Papua was booming.

Port Moresby had an estimated 1000 European inhabitants in 1914, and probably more in 1918. It boasted two banks, a school, two hotels, a telephone service (Stuart 1970), and a 500,000 gallon cement reservoir, from which water was reticulated throughout the town[10]. An advertisement for one of the hotels boasted "Lighted throughout by Electricity" and "Dining Room furnished with electric fans", while the other hotel's advertisement meekly proclaimed, "Premises lighted by Acetylene gas"[11].

Port Moresbians had access to refrigerated goods, as a "cold storage company" commenced operations there in 1913, with facilities for storing "mutton, meat, butter, fruit and vegetables"[12]. Ice was available for purchase at one penny per pound.[13] Motor vehicles had arrived in Port Moresby by 1918.

Fig. 2. The steamship 'Marsina', on which White travelled to Port Moresby

At the news of an armistice in the war in November 1918, it was reported that:

> Motor cars screeched their owners' gladness, and choruses by the parading residents added to the unwonted noise … some of the weary ones then made their way homeward, while others still on celebration bent, motored to Sapphire Creek[14].

At the time of White's visit, Port Moresbians were bemoaning the cold weather:

> The extremely cold weather experienced during the past month has caused a great quantity of sickness, and an epidemic of colds has taken place. Old residents of Papua say they cannot remember such climatic conditions[15].

The lowest overnight temperature at Port Moresby for that year was 68°F (20°C) on the 31st July[16]. A few months later, Papuans and Australians alike were on high alert[17] for the arrival of the influenza pandemic that killed millions of people around the world.

Specimen numbering

Although White (1922) stated that the invitation to visit Papua was "for the purpose of studying its vegetation", it was a plant inventory and specimen collecting survey for White, and only some general notes on the vegetation were recorded.

For the first part of his career, C.T. White used specimen numbers only sporadically, and the great majority of his specimens are unnumbered. It wasn't until the mid-1920s that he sequentially numbered his collections on a more regular basis. His trip to Papua; however, provides an exception, as nearly all of the specimens have a unique number, starting at 1 and finishing with 827, so on the face of it, 827 specimens were collected. However, in two instances, White inadvertently applied the same number to two unrelated specimens, so that the actual number of specimens was 829. All numbers

up to 134 were for specimens labelled 'Port Moresby', his initial destination, and the ensuing numbers relate to his first excursion eastward to Sogeri Plateau and Javararie. This gives one hope that the numbering was strictly chronological, but closer examination reveals that the sequence of White's collecting numbers is only approximately chronological, and the numbering sequence often fails to correspond to the sequence of localities along the route. For the second excursion, the numbering is even more jumbled with respect to the locations. It is clear therefore that White did not allocate numbers to his specimens at the time of collection, and this is corroborated by the absence of a collection number on any of the surviving field slips.

The last few numbers (819–827) were allocated to specimens collected during the first excursion. This reveals that numbering was not done until after the second excursion at the earliest. Because the numbers appear only on the final stamped herbarium label, in ink, I believe that White did not number his specimens until he returned to Brisbane.

Specimen labels

Almost all of White's specimens from his 1918 trip have a rectangular thin paper Queensland Herbarium label with the following information stamped upon it 'Hab. Papuan collections C.T. White No. July/Aug. 1918', where 'Hab.' refers to the locality of the specimen. Upon these labels, White has handwritten (in ink) the species name, locality and the specimen number (**Fig. 3**).

In addition, 40% of the BRI specimens have a small slip of paper (either lying loose or glued to the sheet) that bears White's handwriting in coloured pencil (**Fig. 4**). Such slips often give just a locality name, but sometimes also indicate the exact date of collection, or give a brief description of the plant and even a rough drawing of a fruit etc. Some of the slips are quite dilapidated, and show signs of having been wet, so they were clearly inserted with the specimens at the time of collection. White included such slips (or field labels) with all of his specimens while in the field, to remind him of the location and morphological features,

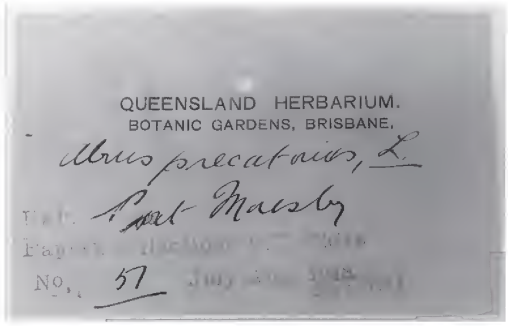

Fig. 3. Example of the herbarium label for specimens from White's Papuan trip. The number showing through from the reverse side is a herbarium database acquisition number.

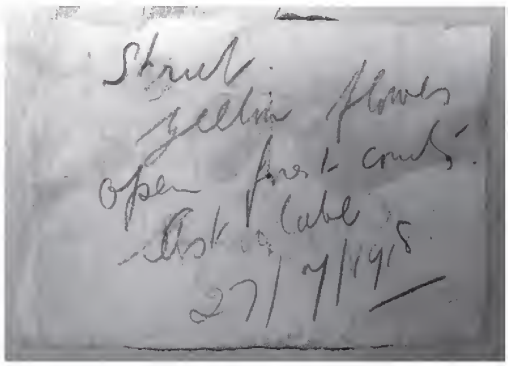

Fig 4. Example of one of White's field slips. This one is more detailed than most.

but many were not ultimately retained with the herbarium specimen.

For his specimen No. 825, *Phrynium kaniense* Loes. & G.M.Schulze, the only locality given is 'Papua, Central Division'. Upon the herbarium label, White has written "Unfortunately, I have lost my field label with this, so cannot give more precise habitat record". This notation makes it clear that he relied entirely upon the field slips for the locality and other data that accompany his specimens, and appear in his report (White 1922). For example, the field label for *Castanopsis acuminatissima* (Blume) Rehder (labelled by White as *Castanopsis Schlenckerae*) says "Large tree, dense foliage, Common, Mafulu, 13/8/18", while the notes

given by White (1922) for that species are "Mafulu. Large tree, dense foliage, common". For about 14% of the specimens at BRI, there is a field label that specifies the actual date of collection. From these it has been possible to piece together White's daily movements during the two excursions.

The specimens

White collected 829 specimens in an estimated 21 collecting days and is a tribute to his endurance and enthusiasm. He confined his collections to the vascular plants, but collected across many families.

Nearly all of White's specimens are well pressed and without mould (**Fig. 5**). However, the quality is often poor; on many specimens the leaves have detached from the stems, and for a proportion of those, the leaves are fragmented and have been placed inside a packet; some specimens consist of fruits or leaves only. The specimen quality varies with both plant group and locality; for example the grasses, sedges and ferns contain a higher proportion of good fertile specimens than average, while very few specimens from the Mafulu and Deva Deva areas are of good quality. About 26% of his specimens at BRI are good intact fertile specimens. Because knowledge of the New Guinea flora was so rudimentary, White obviously opted for quantity rather than quality. He does not enlighten us as to the vicissitudes attending his botanical collecting, except to say that the trip "was of a very hurried nature" (Rogers & White 1920). One major difficulty would have been the rain – in many of the areas he visited, such as Mafulu, "every afternoon is wet, and most of the nights as well" (Grimshaw 1913c). The poor quality of many specimens can likely be attributed to his inexperience in collecting under those conditions. It is also possible that White did not have access to his plant presses during the week-long trip back to Brisbane on the steam ship, in which case any still-moist specimens would have deteriorated.

There are many gaps in the number sequence for specimens at BRI, White's 'home' herbarium. There are three possible reasons for a missing number at BRI.

1. For 18 specimens the herbarium label has been lost, and with it the collection number, thus causing a gap in the number sequence. In this category are all of the 'carpological only' collections.

2. White or others may have discarded some specimens after they had been numbered – this is thought to account for most of the missing specimens (see below), but it is not possible to determine how many have been lost in this way.

3. White sent all material of that specimen to another herbarium. Some specimens in this category have been traced:

Material of Rubiaceae and Acanthaceae was sent to Spencer Moore at the British Museum (BM), who subsequently sent White a letter listing identifications for those[18], and numerous specimens of Zingiberaceae and Marantaceae were passed onto H.N. Ridley at Singapore. D. Prain, the then Director of Kew Gardens, identified his specimens of *Acalypha*, *Macaranga* and *Mallotus* (White 1922). He also sent three bamboo specimens to Kew (numbers 238, 327 & 365) for the examination of Otto Stapf[19], but presumably he had no response, as White (1922) does not acknowledge a contribution by Stapf. Only one of the three bamboo specimens (number 327) is present at BRI and it remains unidentified as *Bambusa* sp. He sent an unknown number of palm specimens to Odoardo Beccari at Florence (FI), but these remained unidentified as Beccari died in 1920. He sent a few pandan specimens to Ugolino Martelli, also at FI. There are two isotype specimens (*Psychotria mafuluensis* S.Moore, no. 416 & *Psychotria whitei* S.Moore, no. 702) at the Arnold Arboretum in Boston, U.S.A., but no other 1918 White specimens are currently known at A. Numerous specimens were sent to the New South Wales herbarium (NSW); *Eucalyptus* for the examination of J.H. Maiden, Loranthaceae for W. Blakely, and ferns for T. Whitelegge; all of these were apparently returned to BRI, although some duplicates remain at NSW. White evidently sent some specimens to Friedrich Markgraf at Friedrich Wilhelm University in Berlin,

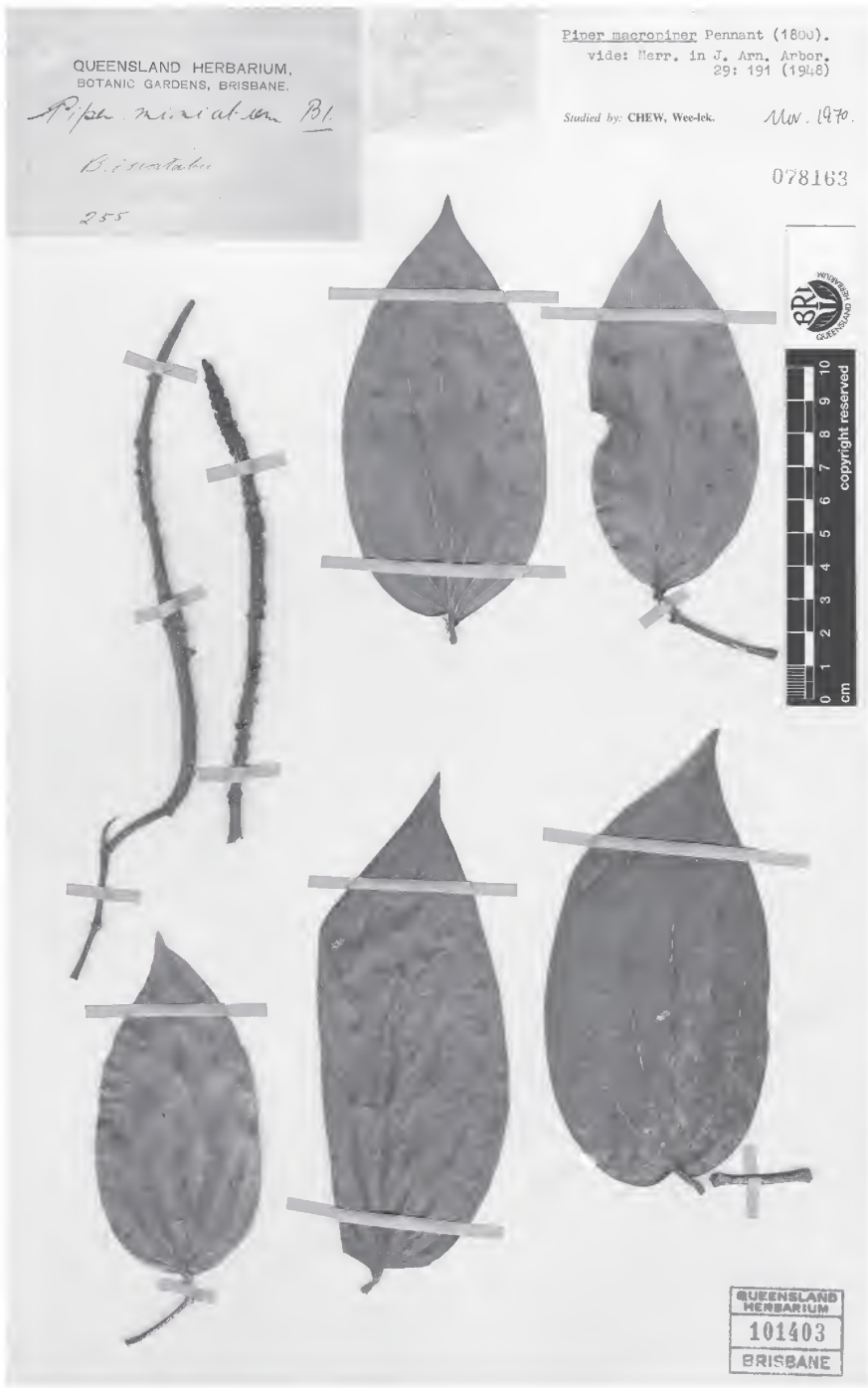

Fig. 5. One of White's Papuan specimens (*Piper macropiper* Pennant, no. 255)

because on the labels of a few specimens at BRI, he has written 'seen by Dr Markgraf, Berlin'.

Statistics

At BRI, there are 665 numbered specimens, and 15 unnumbered (most of the latter were previously numbered, but have lost their herbarium label), making a total of 680 specimens. To this can be added 15 specimens not at BRI but known to be present at another herbarium due to being sent by White.

By comparing the holdings at BRI with the annotated species list presented in White (1922), it is apparent that there are 27 species (all apparently collected by White, hence 27 specimens) collected by White, not now present at BRI, and not listed in any letter or publication associated with any of the authors mentioned above. These include *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult., *Elatostema sessile* J.R.Forst. & G.Forst. and *Opilia amentacea* Roxb. These are perhaps present in another herbarium. Adding in these 27 specimens brings the total to 722.

However, that still leaves 107 specimens for which nothing is known, except White's allocated specimen number. From these we can determine that 24%of the missing specimens are from the number series of the first excursion (Sogeri, Sapphire Ck etc.; 135–414 & 819–827), 13% of the missing specimens are from the Yule Island/Mekeo District number series (705–818), 61% are from the mountainous regions of the second excursion, Mafulu, Deva Deva and Dilava, i.e. the number series 415–704; and just 2% are from the Port Moresby number series (1–134). Taking into account the poor quality of many of White's extant specimens from the wet mountainous areas of the second excursion, it is difficult to avoid the conclusion that there were further poor quality specimens that White numbered but later discarded.

Of the 722 collections that are known, the number of *species* represented is estimated at 562. This is many fewer than the number of specimens, for the simple reason that White collected some species twice or more times (maximum was five times – for *Acalypha hellwigii* Warb., *Scaevola oppositifolia* Roxb. and *Microlepia pseudohirta* Rosenst.). In most cases the duplicated species collections were made from the different excursions or at least from widely separated localities, but surprisingly often they were from the same location. For at least some of those in the latter category, the morphology of the two collections is very similar. This leads one to suspect that the two specimens were actually part of the same gathering that became physically separated from each other during drying activities, and then inadvertently numbered separately by White upon his return.

Port Moresby collection

White ranged widely around Port Moresby in his quest for plant specimens; they include some mangrove species, other maritime plants, grassland and woodland species and a couple from rainforest gullies. White (1922) described the vegetation around Port Moresby:

> It consists for the most part of grass-covered hills with scattered white-barked eucalypts (*E. papuana* and *E. alba*) of rather stunted growth dotted about. Other very common trees on the hills are *Alstonia scholaris* (Milky Pine), and *Albizzia procera.* A cycad (*Cycas media*) is also very abundant… Round about the rocky sea-coast, near the town, *Cochlospermum gillivraei* (a small tree) is conspicuous on account of its numerous large, yellow, buttercup-like flowers.

It was the height of the dry season, and most herbaceous plants would have already died, with many shrubby species senescent or torpid. However, this did not prevent White making a very extensive collection. The specimen quality is often mediocre, reflecting the seasonal conditions. 137 Port Moresby specimens are known: 125 from the number series 1–134, plus no. 513, no. 820 and 10 unnumbered (Queensland Herbarium 2013), all collected within walking distance of the town centre. These could all be geocoded with 1600 metre precision centred on 9° 28' 30"S, 147° 09' 30"E. About 20 Port Moresby specimens have field labels specifying the date as either the 23rd or the 24th July, and it is likely that the great majority were collected on these two dates.

White rested in Port Moresby for a few days following the first excursion, although he undoubtedly spent considerable time attending to the drying of his specimens. There are four dated specimens from this time, all collected on 6th August.

First excursion

On the 25th July, Stanley and White started on an excursion to the Sogeri Plateau and Javararie (**Fig. 6**), **Table 1**. They travelled on horseback[20], and 15 native carriers followed on foot (White 1922). In and near Port Moresby, the carriers were paid with money (one shilling a day), but away from the town they were paid in salt or matches[21]. White was interested to learn that salt was highly prized and that for a tablespoon of salt, the natives would trade a sugar-bag full of sweet potatoes[22]. They headed along the only major road out of the town, to the plantations of the Laloki River (15.5 miles [25 km] from Port Moresby), and onto Sapphire Creek (18 miles [29 km] from Port Moresby), where they camped for the night.[23]

After Sapphire Creek, the track took them onto the base of the Astrolabe Range. White made numerous collections labelled 'Astrolabe Range' (26–27 July), presumably on or near this steep section. This area is the Varirata or Wariarata plateau. Judging by the collection dates, White and Stanley did not stop there until the return journey. They reached Koitaki and Sogeri on the 28th July. Beaver (1905) said of Sogeri:

> Sigoro [Sogeri] is one of the prettiest places I have come across in New Guinea. Some 50 acres of sloping ground have been cleared of jungle... the rainfall is rather better than at Warirata and the soil is even richer. The butterflies are of gorgeous colour, and range in size from an eighth of an inch across to over 8 inches. The jungle birds are equally brilliant in their plumage.

The Sogeri plateau was the site of a large rubber plantation[24] established about 1910, and in full production by the time of White's visit. White (1922) described the vegetation of Sogeri plateau:

> ... the vegetation is very rich and tropical, the plateau being mostly covered with heavy rain-forest in which the usual Malayan orders and genera predominate. Zingiberaceae and Marantaceae are particularly abundant. Mucuna kroetkei is a forest climber with long pendulous racemes of brilliant scarlet flowers and is known locally as the "D'Albertis Creeper"[25]...

Stanley and White camped on the range between Sogeri and Javararie (now Iawarere) on the evening of the 28th July, perhaps leaving the porters at Sogeri. On the 29th July, Stanley and White rode to Javararie, their furthest point on the excursion. This was the site of another rubber plantation, one that produced some of the finest rubber in the Territory (White 1922). They probably returned to Sogeri late on the 29th.

After making further collections around Sogeri, White and Stanley made a detour to Bisiatabu and Hombrom Bluff, to the north of the main track they had been following. They probably arrived in Bisiatabu late on 30th July, as all collections from Bisiatabu and Hombrom Bluff are dated 31st July. Beaver (1905) described the terrain near Hombrom Bluff:

> After quitting Tabouri, we left the Warirata track, and struck off through deep gorges and across steep spurs. The track was very narrow and rough -- 800 feet below, the river seemed a mere silver thread. Presently the eye catches the scarp of Hombrom Bluff, rising almost perpendicularly from the river bank.

Stanley and White then returned to Varirata plateau by the evening of 1st August, where White made a dozen or so collections with the locality given as "Mt Warirata". White (1922) described the vegetation of these areas:

> On the Astrolabe Range (about 3,000 feet), Hombrom Bluff, Mt Warirata etc., the vegetation for the most part is of an open character, the principal forest trees being eucalypts (principally *E. tereticornis*) with patches of *E. alba* and *E. clavigera*, *Casuarina nodiflora, Banksia dentata, Melaleuca* sp. (a Paper-barked Tea-tree), *Diplanthera tetraphylla, Grevillea pinnatifida* and *Timonius Rumphii*. At Bisiatabu, I was interested to find *Nepenthes moorei* to be a common plant in the poorer open, dry, forest country.

They camped on the lower reaches of the Laloki River on the afternoon of 2nd August, arriving early enough to allow White to make about 12 specimen collections. They would have arrived back in Port Moresby in the early afternoon of the 3rd August.

Table 1. Summary of localities visited during White's first excursion to Papua

Locality used by White	Collecting date(s) (year is 1918)	Latitude	Longitude	Altitude[1] (metres)
Astrolabe Range	26 July, 27 July, 30 July, 1 August	9° 25'S	147° 22'E	
Between Koitaki and Sogeri	28 July	9° 24'S	147° 29'E	490
Bisiatabu	31 July	9° 24'S	147° 25'E	510
Hombrom Bluff	31 July	9° 23'S	147° 20'E	653
Javararie (now Iawarere/ Iawarare)	29 July	9° 27'S	147° 37'E	548
Koitaki (now Koitaki Plantation)	28 July	9° 24'S	147° 28'E	479
Laloki River	2 August	9° 24'S	147° 18'E	200
Lawsons Lookout	31 July	9° 24'S	147° 25'E	510
Mt Warirata (now Varirata/ Wariarata Plateau)	1 August	9° 25'S	147° 22'E	573
Ranges between Sogeri and Javararie	28 July, 29 July	9° 26'S	147° 33'E	
Rona Falls (now Rouna Falls)	27 July	9° 25'S	147° 23'E	
Sapphire Creek	25 July	9° 24'S	147° 19'E	220
Sogeri[2]	28 July, 29 July	9° 24'S	147° 29'E	500

Footnotes

[1]Geocodes and altitudes mainly from Geonames website.
[2]The modern location of Sogeri differs considerably from that used by O'Malley & Stanley (1916), and hence by White.

Second excursion

On their second excursion, Stanley and White travelled into the mountainous region of Mafulu, via Yule Island and Bioto (**Fig. 6**).

Stanley attended the first annual dinner of the Public Service Association at Port Moresby on the evening of the 6th August[26], and it is likely that White was present as a guest. Stanley evidently wanted to delay the start of the second excursion so that he could attend this dinner. No details have been discovered about their departure or for the timing of the early part of the journey, but to reach Mafulu by the 11th August (see below), they must have left Port Moresby straight after the dinner, or in the early hours of the following day. It is not known which vessel they boarded to reach Yule Island, but a journey there by steamer from Port Moresby took about six hours[27].

At Yule Island, where there was a Government mission, Stanley employed 25 native porters for "carrying the camping outfit, collecting gear, specimens etc." (White 1922). They travelled from the island (probably late on the morning of 7th August) by native canoes to the nearby mainland, following the Ethel River (Bioto Creek, **Fig. 7**) to the small village of Bioto. White commented that "time did not permit of much collecting along the banks of the Ethel River" but also that he "collected specimens of the apparently little-known *Sonneratia lanceolata*" (White 1922). This *Sonneratia* specimen is the only one at BRI that bears the locality 'Ethel River', although one additional species, *Luffa aegyptiaca* Mill., is listed in White (1922). Stanley and White did not stay the night at Bioto, nor spend much time there. Murray (1912) said of Bioto:

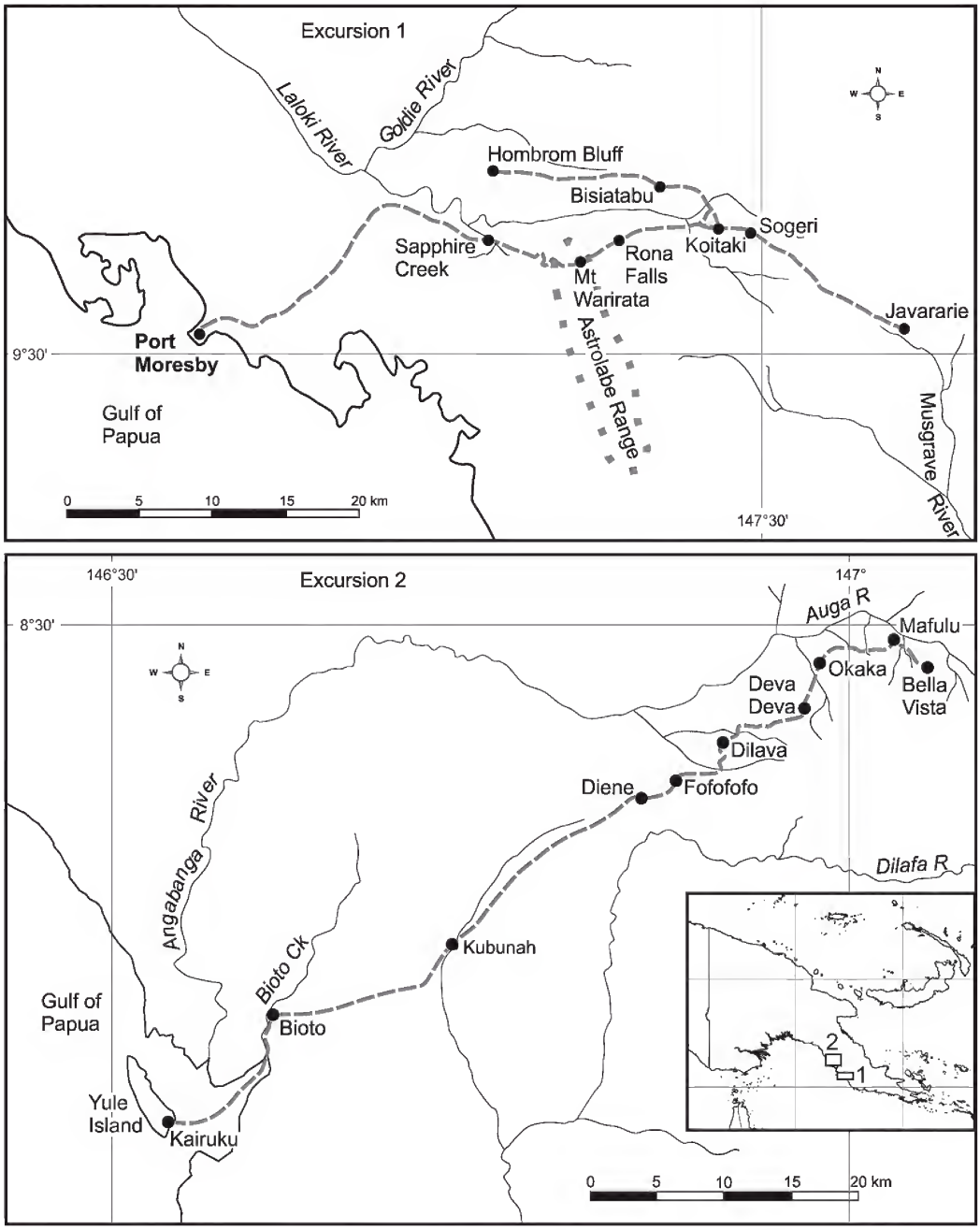

Fig. 6. Routes taken by White during his two excursions in Papua.

The mosquitos swarm there even in the dry season in the blazing midday sun, and the imagination staggers at the thought of what they might be at night. I for one have never passed a night there, and trust that I never shall.

In contrast to the first excursion, the second was entirely on foot. White (1922) stated that from Bioto it was a "five days' march to the mountains" and that the following places were "stopped at *en route*: Kubunah, Fofofofo, Dilava, Deva Deva, Mafulu and Bella Vista". A few of White's 'Mafulu' collections are dated '11/8/1918'. The fact that they reached Mafulu by the 11th August means that they did not dally, and made only overnight stops at each village or mission station on their way inland. It seems very likely that White did little or no collecting until he reached Mafulu. In the early stages of the journey, the porters would have been heavily loaded with the food required to sustain them for the two-week trip; only in the latter stages of the trip (when food stores were reduced) would they have had the capacity to carry the extra weight and bulk of White's botanical specimens. A quick inward trip, with all collecting done on the return journey was the stated strategy employed by the Archbold Expedition many years later (Archbold & Rand 1935).

White did not describe the route they took or the places they camped, but a series of newspaper articles by an unknown author (Anon. 1921a, 1921b, 1921c) detailed a trip following the same route a few years later. This party also started their expedition from Yule Island, landed at Bioto, spent their first night at Kubuna, and travelled onto Mafulu. In addition, Beatrice Grimshaw had written a very interesting account of a trip to Mafulu a few years earlier (Grimshaw 1913a, 1913b, 1913c).

Fig. 7. Bioto Creek, featuring Nypa palms (*Nypa fruticans* Wurmb)[28].

Stanley, White and the porters walked to Kubuna for the first night's camp. They were no doubt anxious to reach the slightly cooler foothills where the mosquitos were not so frequent. Anon. (1921a) described the track from Bioto to Kubuna thus:

We … wound our way through random grass fires in the sunblasted country beyond it, along an uphill stony track, which burned the foot through the sole of the boot. A few miles out, we stepped out of the eucalyptus belt into the ficus scrub, out of the dry heat into the moist, … we had plunged into tropical scrub, which became steadily denser and ran ahead of us for many miles … A three hours' steady tramp brought us to the first of the hill creeks, where we halted to boil tea. The carriers came up, running with sweat, and sat in the water among the rocks.

The next overnight stop for Stanley and White was at Fofo Fofo as described by Anon. (1921b).

Fofo-Fofo … is a clearing of a few acres in the surrounding jungle at a height of something between 2000 and 2500 feet – a clearing made for the rest-hut … Fofo-fofo is what the natives call the bell-bird, which leads the morning chorus here.

The next night they stopped at Dilava (**Fig. 8**) as described by Grimshaw (1913a).

After an almost endless pull up, round a corner we came upon the tiny station of Dilava, perched like a swallow's nest on the top of a sharp-edged peak … on top of the tiny peak were crowded together some small stick buildings – Sister's house, kitchen, school, Father's house, and a church.

The terrain was now very rugged indeed (Grimshaw 1913b).

The track to Deva-Deva … wet by daily rains, is so slippery that no-one could walk on it without nailed boots. No white person, as a matter of fact, ever attempts to do so … on leaving Dilava the track winds down and down from the 3000 feet height on which the mission stands to 1000 feet or so above sea level. After crossing the river, it takes breath and shoots up to 4200 feet in height. The tall tree-like bamboo of the lower range gives way to the exquisite bamboo liane … begonias, shell-pink and scarlet, dangling their full racemes along the track; balsams, pale coral colour; crimson honeysuckle; white, white graceful nameless flowers, appearing in the dim greenness of the bush.

Fig 8. Dilava Mission in 1921[29].

Their next night was spent at Deva Deva (**Fig. 9**) as described by Anon. (1921c).

Deva-Deva, like Dilava, is sited on a tiny promontory of hill-spur which juts out over a deep valley, filled with a sea [of] cloud morning and evening.

White reported that the 25 porters they employed at Yule Island deserted them at Deva Deva. Other natives were soon requisitioned, including four women:

One of the females not only carried a pack weighing 35 lbs, but a young pig which she commandeered on the wayside, and upon which she bestowed much care[31].

The last leg was from Deva Deva to Mafulu. The distance was 13 miles, a distance that the "practiced walkers of the mission could traverse in four hours" (Grimshaw 1913b).

Fig 9. Deva Deva in 1921[30].

It was very, very lovely … there were streams all the way, dropping down from unseen heights among white and pink orchids, and tree-ferns like umbrellas of green lace … there were little flowers like wild roses; there were raspberries, sweet and good; the dim places of the forest were lit with scarlet flames of balsam; and the pines[32], by now, began to thicken.

On the 11th August, Stanley and White arrived at Mafulu. Up to this point, they had been travelling through dense jungle, but at Mafulu (Anon. 1921c):

The valley opens into reaches of open grass land, rich, sunny, well-watered, well-drained soil. Here the villages grow sweet corn in abundance, yams in places cover the hillsides for miles, bananas are common….

Archbold & Rand (1935) hypothesised that the mountain-valley grasslands are formed by deliberate burning, but that "conditions which are dry enough for extensive burning probably occur only once in several years". They further commented that the grasslands were maintained by the continual clearing of the secondary growth for gardens by the natives. White (1922) did not mention grassland at all, but instead stated:

In the ranges about Mafulu (about 4000 feet) the vegetation is extremely rich and varied, consisting almost entirely of heavy rain-forest. Among trees the ordinary Malayan types predominate; ferns, lycopods, begonias, palms, bamboos and other typical tropical forms are abundant. The occurrence of *Grevillea* is a connecting link with the flora of Australia, while *Quercus, Castanopsis* and *Begonia* are Asiatic types not as yet found in Australia.

Davies (1987) recorded that during White & Stanley's trip, Stanley made numerous observations on the geology of the Mafulu area, and discovered a considerable range in age of the volcanic rocks there, from Miocene to Pleistocene. It is clear that Mafulu was Stanley's main objective. Stanley and White spent less than three days at Mafulu (11–13th August), leaving on the afternoon of the 13th. There are 100 extant White collections from there, the largest number for any locality except Port Moresby.

There is nothing in Papua more beautiful than the little mission-house in Mafulu. The house itself, church and kitchen are built of sawn boards—almost a necessity in this damp and chilly climate. The site is magnificent—a little peak four thousand feet high, set in the midst of a ring of splendid mountains … From the verandah, one can see the giant pandanus of the upper ranges dotting the green slopes of the neighbouring peaks (Grimshaw 1913c).

The only collections that White made beyond Mafulu were from Bella Vista station, where there was a garden tended by a priest from Alsace province of France. It was located along the track a few kilometres past Mafulu. White made only eight collections from Bella Vista, so he didn't spend much time there. He must have visited Bella Vista on one of the days that they were encamped at Mafulu. Anon. (1921c) said of Bella Vista:

The oranges in the Alsatian garden of Bella Vista, beyond Mafulu, are the equal of any that grow in the valley of the Murray or in California. We received them by the armful: we could consume no more when we had eaten half a dozen each. Wild balsam flowers of varied colours … adorn the track … right up the Mafulu valley.

As noted before, both the dates on the extant field labels, and the sequence of numbering suggest very strongly that White's collections were made firstly at Mafulu and then during the return journey to Yule Island.

From the relatively few dated field labels, it has been possible to roughly determine White's itinerary, and to infer that the total duration of the journey (from Yule Island back to Yule Island (second day)) was 13 days, that is, from the 7th August to the 19th August (**Table 2**). The numbers of specimens collected at each location allows an estimation of how long the party spent there. A consideration of the number of specimens collected, the dates and distances gives rise to the inevitable conclusion that White must have been snatching specimens from daylight till dusk for much of the return journey, with the pressing and note-taking done after dark in the huts.

The following itinerary is hypothesized: White collects at Mafulu (100 known specimens) and Bella Vista (8 specimens) on the 11th, 12th and 13th August, and walks back to Deva Deva for the night of the 13th. He collects at Deva Deva (50 known specimens) on the 14th, and travels onto Dilava for the evening of the 14th. Further collecting at Dilava (25 known specimens) on the morning of the 15th and on to Fofofofo (16 specimens) for the night. On the 16th they travel from Fofofofo to Diene (3 specimens) and onto Kubunah (3 specimens), a distance of about 20 km as the crow flies. On the 17th, they travel from Kubunah through the Mekeo District (31 specimens) to Bioto (7 specimens), and then by canoe via Ethel River (2 specimens) back to Yule Island, possibly arriving after dark. On the 18th and 19th, collecting is carried out at Yule Island (70 specimens).

The Mekeo District was a name used for a large amorphous tract of lowland country adjacent to Yule Island. It seems that White applied the name 'Mekeo District' to specimens he collected between Kubunah and Bioto, as there are no specimens with the latter designation, but there are several specimens labelled 'between Kubunah and Fofofofo' or 'between Fofofofo and Dilava'.

White left Papua on the steamship 'Morinda', along with 29 other passengers[33], on the 23rd August[34], and he arrived back in Brisbane early on the 30th August 1918[35]. The total time away from Brisbane was just six and a half weeks, with four and a half weeks spent in Papua.

Table 2. Summary of localities visited during White's second excursion in Papua

Locality used by White	Collecting date(s) (year is 1918)	Latitude[1]	Longitude[2]	Altitude[3] (metres)
Bella Vista (now Belavista)	12 August or 13 August	8° 33'S	147° 03'E	1450
Bioto	17 August	8° 44'S	146° 37'E	15
Deva Deva	14–15 August	8° 33'S	146° 58'E	770
Diene	16 August	8° 38'S	146° 51'E	480
Dilava	14–15 August	8° 35'S	146° 56'E	870
Ethel River (now Bioto Creek)	17 August	8° 46'S	146° 36'E	5
Fofofofo (now Fofo Fofo)	15 August	8° 37'S	146° 53'E	
Kubunah (now Kubuna Mission)	16 August	8° 42'S	146° 45'E	100
Mafulu	11–13 August	8° 33'S	147° 00'E	1250
Mekeo district	17 August	8° 42'S	146° 40'E	50
Yule Island[4]	18–19 August	8° 49'S	146° 32'E	10

Footnotes
[1]seconds of arc have been truncated
[2]seconds of arc have been truncated
[3]Altitude figures have mostly been gleaned from Archbold & Rand (1935)
[4]Yule Island geocode is for Kairuku Government station (see Murray 1912). One of White's specimens (n. 772) actually specifies 'Kairuku' as the locality

Results of the survey

Despite the brevity of his Papuan visit, and the climatic challenges for specimen collecting, as evidenced by the poor quality of many specimens, the survey was undoubtedly significant in terms of new taxa discovered (**Table 3**). Several botanists had preceded White on the route of his first excursion to Sogeri and Javararie, but he was the first botanist to collect specimens from the non-coastal areas of his second excursion, i.e. between Kubuna and Mafulu. As a consequence, numerous species collected from his second excursion were undescribed. 34 new taxa were named from specimens collected by White during his trip, including 15 new taxa authored or co-authored by White (**Table 3**).

The taxonomic scope of his collection

White made numerous collections of some plant families or groups, while other families or groups were apparently ignored.

He made an impressive collection of 90 ferns, including 14 Dennstaedtiaceae and 9 Pteridaceae, perhaps with the knowledge that he could later ask for identifications from Thomas Whitelegge at NSW. He collected 70 grasses (Poaceae), 50 pea-flowers (Fabaceae), and 43 Rubiaceae. Other well collected families include the Gingers (Zingiberaceae), Marantaceae, Asteraceae, Acanthaceae, and Euphorbiaceae.

On the other hand, White collected no filmy ferns or tree-ferns, no water-plants, and nothing from the families Araliaceae, Celastraceae, Cunoniaceae, Flacourtiaceae and Icacinaceae, all of which are highly speciose in New Guinea. Other omissions were the families Chrysobalanaceae, Clusiaceae, Loganiaceae, Monimiaceae, Musaceae, Symplocaceae and Thymelaeaceae. The genus *Begonia*, with scores of species in New Guinea, is represented by two collections; he collected no gymnosperms apart from two

Cycas collections, and just three collections each of Gesneriaceae and Annonaceae.

In many cases, the 1918 specimen collected by C.T. White was the first New Guinea record for that species to be incorporated in the Queensland Herbarium. With the many ensuing collectors and collections, nearly all species have been collected numerous times since, but there are still some species not represented at BRI by any specimen other than that of White (*Amaracarpus cuneifolius* Valeton, *Brachyachne ambigua* Ohwi, *Dendrocnide cordata* (Warb. ex H.J.P.Winkl.) Chew, *Echinochloa picta* (K.D.Koenig) P.W.Michael, *Eriolopha ovalifolia* Ridl., *Macaranga coggygria* Airy Shaw, *Pandanus yuleensis* H.St.John, *Riedelia whitei* Ridl., *Timonius cryptophlebus* S.Moore and *Waltheria indica* L.).

Naturalised species

White's collection of 50 naturalised species is an important subset of his Papuan collection and represents the earliest substantial vouchering of naturalised taxa in New Guinea. Some are perennial shrubs e.g. *Jatropha gossypiifolia* L., but most are herbaceous annuals e.g. *Bidens pilosa* L., and several vines are also included e.g. *Cardiospermum halicacabum* L. The major represented families are Malvaceae (9), Poaceae (9), Asteraceae (7) and Fabaceae (6). Most of the naturalised species were collected at Port Moresby, but three were collected from Yule Island, three (*Bixa orellana* L., *Dichrocephala integrifolia* (L.f.) Kuntze and *Urena lobata* L.) were gathered from Mafulu, three from Sogeri, two from Sapphire Creek, two from Laloki River, and one each from Bella Vista, Bisiatabu, Astrolabe Range and Javararie. There is a marked positive correlation between the number of naturalised species collected and the permanence or size of the human settlement. His collection also included at least one cultivated species (*Ficus callophylla* Blume, from Port Moresby).

Despite the fact that White had been in Papua for just four and a half weeks, he was, in the 1920s, the only Australian botanist in the Government employ who knew anything about the flora of Papua, so he was quickly considered an expert. He promoted exploration and collecting by others, and in 1925 he was instrumental in having a young Toowoomba man, Leonard Brass, appointed as botanical collector for the Arnold Arboretum in Boston, U.S.A. (Frodin 1990: 200). Brass was to become a very significant plant collector in New Guinea. White himself returned to New Guinea in 1944 and 1945.

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Table 3. New taxa named from White's 1918 Papuan specimens

Taxon name	Family
Buchanania papuana C.T.White	Anacardiaceae
Cupaniopsis insularis Radlk.	Sapindaceae
Cupaniopsis papuana Radlk.	Sapindaceae
Dendrochilum murrayi Rogers & C.T.White	Orchidaceae
Desmodium papuanum C.T.White	Fabaceae
Diospyros ferrea var. *villosa* Bakh.	Ebenaceae
Eriolopha ovalifolia Ridl.	Zingiberaceae
Goodyera hispidula Rogers & C.T.White	Orchidaceae
Grevillea densiflora C.T.White	Proteaceae
Grevillea subargentea C.T.White	Proteaceae
Habenaria ramosa Rogers & C.T.White	Orchidaceae
Helicia latifolia C.T.White	Proteaceae
Helicia validinervis C.T.White	Proteaceae
Hemigraphis ciliata S.Moore	Acanthaceae
Hemigraphis whitei S.Moore	Acanthaceae
Hulemacanthus S.Moore	Acanthaceae
Hulemacanthus whitei S.Moore	Acanthaceae
Ixora whitei S.Moore	Rubiaceae
Justicia platyphylla S.Moore	Acanthaceae
Loranthus barbellatus Blakely	Loranthaceae
Mucuna stanleyi C.T.White	Fabaceae
Mussaenda whitei S.Moore	Rubiaceae
Phacelophrynium whitei Ridl.	Marantaceae
Physurus bicalcaratus Rogers & C.T.White	Orchidaceae
Psychotria decorifolia S.Moore	Rubiaceae
Psychotria mafuluensis S.Moore	Rubiaceae
Psychotria whitei S.Moore	Rubiaceae
Riedelia lanatiligulata Ridl.	Zingiberaceae
Riedelia whitei Ridl.	Zingiberaceae
Ripogonum papuanum C.T.White	Ripogonaceae
Semecarpus undulata C.T.White	Anacardiaceae
Spathoglottis papuana var. *puberiflora* Rogers & C.T.White	Orchidaceae
Terminalia okari C.T.White	Combretaceae
Timonius cryptophlebus S.Moore	Rubiaceae

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Endnotes

[1] Newspaper notification; The Brisbane Courier, 10 November 1917, p. 11.
[2] Newspaper article; The Capricornian, 17 November 1917, p. 27.
[3] photograph in Queensland Herbarium archives. The object in White's hands is not known.
[4] Letter from C.T. White to W. Bradtke, dated 13 July 1918. (Queensland Herbarium archives).
[5] Newspaper article: The Brisbane Courier 17 July 1918, p. 11.
[6] Newspaper notification; The Sydney Morning Herald, 15 July 1917, p. 8.
[7] Newspaper advertisement; The Brisbane Courier, 1 October 1918, p. 2.
[8] Newspaper notification; The Papuan Courier, 26 July 1918, p. 4.
[9] Newspaper article, Chronicle, 7 December 1918, p. 30.
[10] Newspaper article, The Register, 7 September 1916, p. 7.
[11] Newspaper advertisement, The Papuan Courier, 9 August 1918, p. 8. (Fryer Library microfilm).
[12] Newspaper article, Townsville Daily Bulletin, 4 January 1913, p. 12.
[13] Newspaper article, The Brisbane Courier, 26 February 1914, p. 7.
[14] Newspaper article, Cairns Post, 20 November 1918, p. 7.
[15] Newspaper article, The Papuan Courier, 9 August 1918, p. 4.
[16] Newspaper article, The Papuan Courier, 9 August 1918, p. 4.
[17] Newspaper article, Cairns Post, 13 December 1918, p. 5.
[18] Lists compiled by S. Le Moore, undated. (Queensland Herbarium archives).
[19] Letter from C.T. White to D. Prain, Director, Kew Gardens, dated 28th February 1919. (Queensland Herbarium archives).
[20] Newspaper article – The Queenslander, 14 September 1918, p. 11.
[21] Newspaper article – The Queenslander, 14 September 1918, p. 11.
[22] The Border Morning Mail and Riverina Times, 17 September 1918, page 4
[23] Some of White's Sapphire Creek specimens are dated 25th July.
[24] Townsville Daily Bulletin, 4 January 1913, p. 12.
[25] Named for the well known Italian collector Luigi D'Albertis (1841–1901).
[26] Newspaper article, The Papuan Courier, 9 August 1918, p. 5.
[27] Newspaper article, The Sydney Morning Herald, 14 April 1915, p. 5.
[28] Frank Hurley, 1921, National Library of Australia nla.pic-vn3314284.
[29] Frank Hurley, 1921, National Library of Australia nla.pic-vn3314344.
[30] Frank Hurley, 1921, National Library of Australia nla.pic-vn3316087.
[31] Newspaper article, The Border Morning Mail and Riverina Times, 17 September 1918, p. 4.
[32] Presumably Hoop Pine (*Araucaria cunninghamii*).
[33] Newspaper notification; The Papuan Courier, 30 August 1918, p. 4.
[34] Based on seven day's travel time from Port Moresby to Brisbane.
[35] The arrival date of 30th August in Brisbane has been confirmed by a passenger list for the Morinda (National Archives of Australia, Brisbane office). An "a.m." arrival in Brisbane is based on travel time of 2.5 days from the reported arrival in Sydney on the evening of 1 September (The Sydney Morning Herald, 2 September 1918, p. 8).

The botanical collections of Ebenezer Cowley

John Leslie Dowe

Summary

Dowe, J.L. (2014). The botanical collections of Ebenezer Cowley. ***Austrobaileya* 9(2): 263–278**. Ebenezer Cowley (1849–1899) was active as a botanical collector in north Queensland and British New Guinea (now Papua New Guinea) during 1889–1898. His official role was Overseer of the Kamerunga State Nursery. Cowley sent all his specimens to F.M.Bailey, Government Botanist in Brisbane. About 370 Cowley specimens have been located, and most of these, *c.* 330, are extant at BRI. A small number (*c.* 40) of duplicates and unicates are housed at BM, CNS, DNA, K, L, M, MEL and NSW. The provenance of Cowley's north Queensland collections included mostly the Kamerunga and Barron River areas. 47 Cowley specimens are significant in typification, mainly through the taxonomic work of F.M.Bailey: of these, 19 are associated with species names in current use. The taxa that involved Cowley specimens in typification are listed with annotations. Cowley's 1st daughter, Clara Moxon (née Cowley) (1875–1905) also sent plant specimens to, and corresponded with, F.M.Bailey.

Key Words: Ebenezer Cowley, Clara Cowley, Queensland plant collectors, Kamerunga State Nursery, typification of north Queensland plants, F.M.Bailey

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Introduction

Ebenezer Cowley (born 18 Apr. 1849, died 9 Feb. 1899) (**Fig. 1**) was active as a botanical collector in north Queensland and Papua New Guinea (then known as British New Guinea) during 1890–1898. His birth was registered in Cirencester District, England, and his first years were spent in Fairford, Gloucestershire (Barrett 2013a). Details of his early schooling are unknown, but he migrated to South Africa prior to 1871 and trained at the Durban Botanic Gardens as a horticulturist (Gibbney & Smith 1987). In South Africa, he studied the flora of Natal whilst engaged in the sugar milling industry (Stephens 1981). Leaving South Africa in 1873, he travelled to Australia and later to Fiji (1874?) where he was involved with sugar milling. Moving to Queensland in 1881, he managed the CSR Victoria Plantation, near Ingham, until 1885 (Griggs 2003), after which he joined his cousin Alfred Sandlings Cowley (later Sir Alfred) in pastoral and sugar-cropping activities on properties in the Herbert River area and Mourilyan (Stephens 1981; Saunders 2013).

Fig. 1. Photograph of Ebenezer Cowley, 1890. Photographer unknown, courtesy of the Cairns Historical Society.

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In 1889, Cowley was appointed the first Overseer of the Kamerunga State Nursery near Cairns, a position he held until his death from liver disease in 1899 (Stephens 1981; George 2009). In Cowley's first year at Kamerunga, Government Botanist F.M.Bailey noted that Cowley had "during the past year collected specimens of several interesting plants" (Bailey 1891). Cowley contributed to matters regarding tropical horticulture and was regularly quoted with respect to his knowledge on the subject (Shelton 1892; Anon. 1896; Sim 2001, 2012). Griggs (2003) noted the apparent lack of formal training with regard to Cowley's sugar varietal research activities, and the subsequent relocation of sugar cane research to Mackay in central Queensland in the late 1890s (Griggs 2011).

The Kamerunga State Nursery (from 1940 known as Kamerunga Research Station) was established in 1889, as an initiative of the newly formed Queensland Department of Agriculture. The Nursery's primary emphases were trialling and experimenting with tropical crops of commercial interest (Thomatis 1895; Benson 1914; Stephens 1981; Barker & Byford 1988). Because of wartime austerity, the Nursery closed in 1916, and the land was put up for lease. In 1940, part of the grounds were reacquired by the Department of Agriculture and Stock, and used as a research station until the late 1990s (Cairns Plan 2005). The grounds are now occupied by Cairns Water, private housing, part of the Kamerunga Conservation Reserve, and vacant allotments. Some of the former plantings still exist as remnants within the area.

During the period when Cowley was Overseer at the Nursery, some significant introductions were trialled (Bailey 1910), including *Carthamus tinctorius* L. (safflower), *Castilla elastica* Sesse (Panama rubber), *Cocos nucifera* L. (coconut palm), *Coffea arabica* L. (coffee), *Cola acuminata* (P.Beauv.) Schott & Endl. (cola nut), *Elaeis guineensis* Jacq. (oil palm), *Ficus elastica* Roxb. ex Hornem. (India rubber), *Garcinia mangostana* L. (mangosteen), *Hevea brasiliensis* (Willd. ex A.Juss.) Muell.Arg. (para rubber), *Maranta arundinacea* L. (white arrowroot), *Musa acuminata* Colla (banana), *Musa textilis* Née (Manilla hemp), *Nicotiana tabacum* L. (tobacco), *Spondias cytherea* Sonn. (vi-apple), *Thea chinensis* Sims (tea), *Theobroma cacao* L. (cocoa) and *Vanilla planifolia* Andrews (vanilla). Possibly the most significant introductions included sugar varieties (Griggs 2003, 2011), some of which were collected by Cowley during visits to Papua New Guinea in 1892–1893 (van Steenis-Krusemen 1950), and by Henry Tryon, then Qld Government Entomologist, in 1895 (Stephens 1981; Griggs 2003, 2011). A breeding program at the Nursery involving forms of *Carica papaya* L. (pawpaw) resulted in the development of the 'Cowleyii' and the 'New Guinea' varieties – the former a dioecious type and the latter an hermaphrodite (Stephens 1981). Not so fortuitous was the introduction of a current weed of national significance *Prosopis pallida* (Humb. & Bonpl. ex Willd.) Kunth (algaroba) that was propagated and subsequently distributed by the Nursery in 1895 (AWC 2012). Other plants that were grown at the Nursery, such as *Castilla elastica* (Panama rubber), *Parmentiera aculeata* (Kunth) L.O.Williams (candle tree) and *Turbina corymbosa* (L.) Raf. (turbina) are now well established invasive weeds in the Barron River Gorge area and the latter throughout the Wet Tropics. Cowley was active in establishing both *Cocos nucifera* (coconut) and *Terminalia catappa* L. (beach or sea almond) on the Cairns foreshore and nearby islands, both of which did not occur in the immediate area prior to that introduction, but have since become ubiquitous, and seemingly natural, components of the strand vegetation.

Publications

Cowley was a productive author on the subject of tropical crops and horticulture (Cowley 1890–1898). He published regularly as a horticultural journalist in the *Cairns Post*, *Cairns Observer* and the *Morning Post* (for examples see, Cowley 1890, 1891, 1892, 1897a–c). These articles mostly covered a single plant species, and were informative, knowledgeable and written in a simple style. Additionally, he contributed

a series of technical papers to the peer-reviewed *Queensland Agricultural Journal* on various tropical fruits, fibres, herbs and crops (Cowley 1897d–j, 1898a–c, 1899a–b). Cowley appears to have made no direct input into taxonomic publications, and only rarely wrote on indigenous plants. For example, he wrote of *Elaeocarpus bancroftii* F.Muell. & F.M.Bailey as a potential nut crop, and provided anecdotes on endocarp extraction and the labours involved (Cowley 1890–1898).

Botanical collections

It is not known if the role of botanical collector was included as one of Cowley's responsibilities as Overseer at the Kamerunga State Nursery. I am not aware of any direct references to this in the Annual Reports from either himself or F.M.Bailey. However, Cowley was particularly active as a collector during the first years of his tenure at the Nursery. His most productive collecting years were 1892–1894, which resulted in the publication of many new taxa by F.M. Bailey in the following years. It appears that Cowley sent all his specimens to Bailey in Brisbane. Bailey, and later other botanists, only ever distributed a small number of these specimens, either as duplicates or unicates, to other herbaria. A further active period of collecting in 1897 produced a corresponding increase in publication of new taxa by F.M Bailey from 1897 to 1900. Otherwise, Cowley made collections in every year 1890–1898. Cowley's primary collecting locations were Kamerunga and Barron River (about 180 specimens), but other north Queensland localities included Cooktown, Daintree River, Johnstone River, Kuranda, Mourilyan, Port Douglas, Russell River, Tolga and Trinity Bay; in Torres Strait (about 50 specimens) on Thursday Island and Dalrymple (Damuth) Island; and in Papua New Guinea (about 30 specimens) at Port Moresby and Kwato Island.

By the time Cowley took up residence in Kamerunga in 1889, access to the Barron River area was possible because of the establishment of service tracks, such as the Douglas and Smith tracks, to the Hodgkinson Goldfield in 1876. Construction of the Cairns to Herberton railway line was commenced in 1886 [and eventually completed in 1910], and tracks to the railway construction sites were established at many locations. The railhead construction camp was adjacent to the Kamerunga State Nursery (Stephens 1981). Agricultural activities and other industries were well advanced on the banks of the lower Barron River by this time. Although other botanical collectors, such as F.M. Bailey in 1877, Stephen Johnson in 1891, L.G. Nugent in 1894–1897 and G. Podenzana in 1891–1893, had visited the area prior to and during Cowley's time at Kamerunga (Orchard 1999; George 2009), few of their specimens from this area were associated with the description of new taxa. Cowley was subsequently the most significant collector of taxa that have their type locality in the Kamerunga and Barron River Gorge areas (Dowe *in prep.*). Cowley's collecting dates and locations are presented in **Table 1**. Correspondence from Bailey to Cowley during this period is archived in the Queensland Herbarium library as part of the F.M.Bailey Letterbooks collection.

Bailey noted that Cowley's 1st daughter Clara Cowley [born 1875; died 1905] was involved with the collection of some specimens. Clara married William Ernest Moxon in 1893, and moved away from Cairns at the end of that year (Barrett 2013b). In the protologue of *Lycopodium clarae* F.M.Bailey (= *Phlegmariuris dalhousieanus* (Spring) A.R.Field & Bostock), Bailey (1893a) noted "*After Miss Clara Cowley, a young energetic collector of the Barron River flora*". The type of *L. clarae* was initially cited as "*Upper Freshwater Creek, E. Cowley*"; later, Bailey (1902) noted a collection "*Upper Freshwater Creek, Miss Clara Cowley*". In correspondence between Bailey and E. Cowley, it was indicated that Clara was despatching specimens in her father's absences. In other correspondence, Bailey requested additional material of *L. clarae*. This was in turn despatched by Clara who most likely obtained a sample from plants growing in the shade houses at the Kamerunga State Nursery. The type specimen of *L. clarae* at BRI appears to

Table 1. The dates and locations of Cowley collections, based on specimen label data

Date	Location
1889–1898	Kamerunga, Barron River, Stoney Creek, Rocky Creek, Freshwater Creek, Cairns
March 1890	Thursday Island
Dec. 1892–Jan. 1893	Papua New Guinea (Port Moresby, Kwato Island)
May 1893	Thursday Island & Yule Island (Papua New Guinea)
Jan. 1894	Port Douglas
June 1894	Port Douglas/Daintree River
Sept. 1897	Mourilyan

include two elements: one the original part collected by E. Cowley at Upper Freshwater Creek, and another, most likely collected from a cultivated plant at Kamerunga as noted above, and otherwise sent to Bailey by Clara Cowley, hence Bailey's reference to this effect. However, it is not possible to determine which element is which, and the complete sheet is being interpreted as the type specimen (Field & Bostock 2013).

In the protologue of *Erycibe paniculata* var. *coccinea* F.M.Bailey, Bailey (1893b) noted: "*I am indebted to Miss Cowley, of Kamerunga, for the ripe fruit of the above plant, which she says is of a pleasing cardinal red*". From correspondence between Bailey and E. Cowley, it was evident that Clara Cowley did indeed despatch the seeds. However, the type specimen *Cowley 71d*, consists of a single leaf and a portion of stem with remnant inflorescence bases. The fate of the seeds is not known or if they were indeed preserved by Bailey as a specimen. An example of Ebenezer Cowley's handwriting is presented in **Fig. 2**. An example of Clara's handwriting has not been located.

In his early years of collecting from 1891 through to 1895, Cowley despatched his specimens to Bailey in batches of about 10–30 specimens. The specimens were numbered sequentially and appended with an alphabetic addition. For example, in April 1892, one batch was numbered 7A to 23A, a subsequent batch sent in May was labelled 24A to 51A, and later another 51A to 74A, and so on until 100A was reached. After this, numbering started again at 1 but the alphabetic addition was changed to 'B'. Thus the following batch, in June, was numbered 1B–18B, and so on. This system continued with four '100 specimen' batches, each appended by A, B, C or D. Bailey and Cowley used these numbers in correspondence when referring to identifications or requests for additional materials. For many specimens, Cowley attached a cardboard label with a reinforced eyelet to his specimens (**Figs. 2** and **3**). Correspondence between Bailey and Cowley indicated that Bailey supplied Cowley with labels upon request. Cowley used this numbering system consistently from early 1892 through to July 1895. However, from May 1893 onwards, Cowley concurrently numbered some specimens seemingly randomly, including single despatches or small batches of specimens that were not included in his larger batches. In many cases, the same collection number was used multiple times for different specimens. For example, between May 1893 and September 1897, there are four specimens labelled as '1', five as '2', seven as '3', and so on. Ultimately, the numbering of the Cowley specimens does not provide reliable chronology or location data, although collection numbers appended with an alphabetic addition, i.e., A, B, C or D, can in most cases be related to certain batches and collection times. Annotations on most of the labels included the original Cowley number with other information on one or both sides. Upon identifying the taxon, Bailey wrote on the same label the species name and

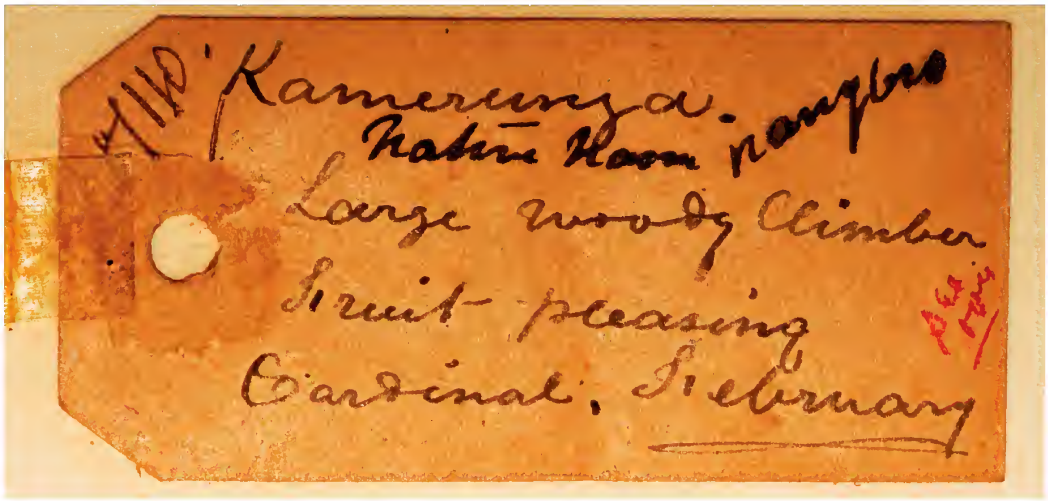

Fig. 2. One side of a label that Cowley attached to his specimen of *Erycibe coccinea* (BRI).

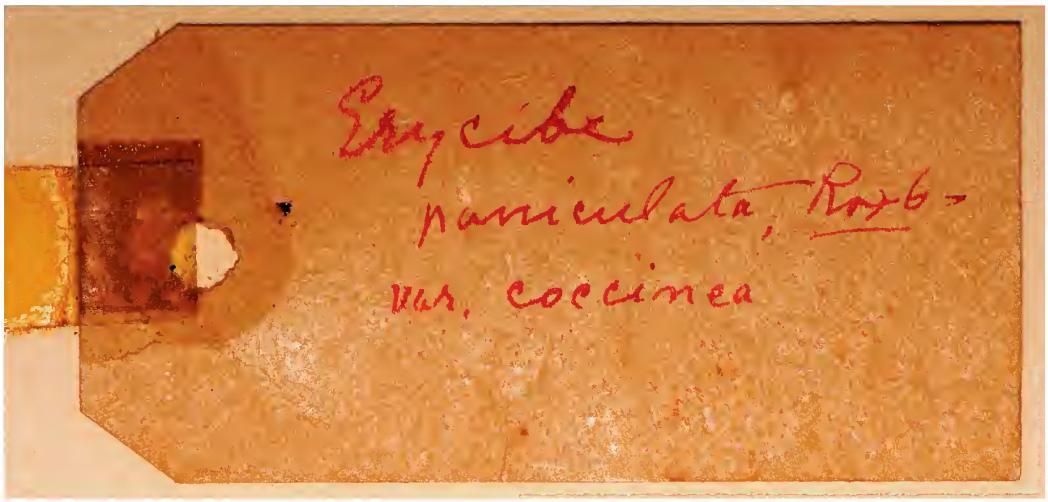

Fig. 3. Reverse side of label in Fig. 2, with the species name written by F.M. Bailey.

in some cases additional information that Cowley may have provided in accompanying correspondence **(Fig. 3).**

Summary of collections

About 370 Cowley specimens have been located. Most of these (*c.* 330) are extant at BRI. A few cited in protologues have not been found. Duplicates and unicates have been located at BM (8 types); CNS (1, no types); K (11 types); L (1 type); M (1 type); MEL (10 types); and NSW (13, 1 type). Of the Cowley specimens, at least 74 (from all herbaria) are involved in typification (holotypes 33; isotypes 32; lectotypes 6; syntypes 3); of these, 19 are associated with currently accepted species names (**Table 2**). Both Ebenezer Cowley and Clara Cowley are commemorated in the names of taxa (**Table 3**) as well as place names in the Cairns area, including Cowley Beach, Cowley Falls and Cowley Street, Kamerunga (DNRM 2013).

Table 2. Taxa for which a Cowley specimen is involved in typification. Individual taxa are number 1 to 47 and arranged in families. Annotations include original name, the type citation, typification, the currently accepted name (in bold), and a reference to the most recent or most relevant application of the names. Queensland Herbarium specimen numbers (AQ) are given for each type to minimise ambiguity where there are multiples of the same Cowley collection number.

Apocynaceae

1. *Ochrosia cowleyi* F.M.Bailey, *Queensland Agric. J.* 1(3): 229 (1897). **Type citation:** *Dalrymple Island, from where Mr. E.Cowley brought the plant now flowering at the Kamerunga State Nursery.* **Type:** Cult. Kamerunga State Nursery [ex Dalrymple Is.], undated, *E.Cowley s.n.* (holo: BRI [AQ332864]). = **Neisosperma oppositifolium** (Lam.) Fosberg & Sachet, *Adansonia* 17(1): 48 (1977); Barker & Telford (1993: 321).

2. *Vincetoxicum pachylepis* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 79 (1893); *Cynanchum pachylepis* (F.M.Bailey) Domin, *Biblioth. Bot.* 89: 531 (1928). **Type citation:** *Kamerunga, E.Cowley.* **Type:** Queensland. Cook District: Kamerunga, Barron River, January 1893, *E.Cowley 67D* (holo: BRI [AQ333088]). = **Marsdenia araujacea** F.Muell., *Fragm.* 6: 135 (1868); Forster (1995: 732).

3. *Wrightia millgar* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 7: 65 (1893); *Wrightia laevis* var. *millgar* (F.M.Bailey) Ngan, *Ann. Missouri Bot. Gard.* 52: 137 (1965). **Type citation:** *Barron River, E.Cowley.* **Type:** Queensland. Cook District: Barron River, undated, *E.Cowley 7D* (holo: BRI [AQ332925]). = **Wrightia laevis Hook.f.,** *Fl. Brit. India [J.D. Hooker]* 3: 654 (1882); Ngan (1965: 137).

Araceae

4. Amorphophallus galbra F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 7: 68 (1893). **Type citation:** *Barron River, and known, according to Mr. E.Cowley, by the name of Galbra.* **Type:** Queensland. Cook District: Barron River, undated, *E.Cowley s.n.* (holo: BRI [AQ332961]); Hay (2011: 252).

5. Rhaphidophora australasica F.M.Bailey, *Queensland Agric. J.* 1(6): 452 (1897). **Type citation:** *Scrubs on range about Cairns, E.Cowley.* **Type:** Queensland. Cook District: Cairns, undated, *E.Cowley s.n.* (holo: BRI [AQ333010]; iso: K); Hay (1993: 296).

6. *Rhaphidophora lovellae* F.M.Bailey, *Queensland Agric. J.* 1: 453 (1897). **Type citation:** *About 20 miles from Cooktown, Miss Lovell; and ranges about Cairns, E.Cowley.* **Type:** Queensland. Cook District: Near Cooktown, undated, *S.Lovell s.n.* (lecto: BRI, *fide* Forster & Dowe 2014). = **Epipremnum pinnatum** (L.) Engl., *Pflanzenr.* 37: 60 (1908).

Arecaceae

7. *Calamus jaboolum* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 13: 14 (1896). **Type citation:** *Mr. E.Cowley tells me that the aborigines at the Barron River, also distinguish three kinds by name – viz. Moti, Jaboolum, and Moologum.* **Type:** Queensland. Cook District: Barron River, undated, *E.Cowley 2 & 3* (holo: BRI [AQ24174]). = **Calamus australis** Mart., *Hist. Nat. Palm. Edn 1,* 3: 213 (1838); Dowe (2010: 60).

8. Calamus moti F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 13: 13 (1896). **Type citation:** *From Mr Cowley I have stem and foliage specimens, and a promise of flower and fruit specimens when available... Mr Cowley tells me that the aborigines at the Barron River also distinguish three kinds by name – viz. Moti, Jaboolum, and Moologum.* **Type:** Queensland. Cook District: Barron River, undated, *E.Cowley 1* (holo: BRI [AQ24176]); Dowe (2010: 64).

9. Livistona muelleri F.M.Bailey, *Queensl. Fl.* 5: 1683 (1902). **Type citation:** *Cairns, E.Cowley.* **Type:** Queensland. Cook District: Cairns, October 1900, *E.Cowley s.n.* (holo: BRI [AQ425082]).

***Note*:** Cowley died in 1899, so the year 1900 may relate to when Bailey received the specimen rather than collection date (Dowe 2009: 260).

Aspleniaceae

10. *Asplenium simplicifrons* var. *laciniatum* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 13: 16 (1896). **Type citation:** *The plant was found by an Aboriginal and brought to Mr Hobson, of Kuranda, who is now cultivating it in his bush-house. Mr E.Cowley, of Kamerunga, from whom I received the specimens, says that the forked fronds are seldom formed, but those with the lacinate margins are very numerous.* **Type:** Queensland. Cook District: Kuranda, Hobson, undated, received through *E.Cowley s.n.* (holo: BRI [AQ144641]). = **Asplenium simplicifrons** F.Muell., *Fragm.* 5: 74 (1865); Brownsey (1998: 302).

Asteraceae

11. *Conyza elata* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 78 (1893), *nom. illeg. non* Kunth. & Boucheé. **Type citation:** *Abounding in the scrubs of the Russell River, and attaining the height of 12 or 14 ft., Bellenden-Ker Expedition; Barron River Scrubs. E.Cowley.* **Type:** Queensland. Cook District: Stoney Creek, Barron River, undated, *E.Cowley 72B* (lecto: BRI, 2 sheets [AQ370513]; *fide* Forster & Dowe 2014).
= **Blumea riparia** (Blume) DC., *Prodr.* 5: 444 (1836); CHAH (2011).

Bignoniaceae

12. *Diplanthera hirsuta* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 14: 11 (1896); *Deplanchea hirsuta* (F.M.Bailey) Steenis, *Recueil Trav. Bot. Neerl.* 920 (1927). **Type citation:** *Stony Creek, Cairns (a shoot and loose flowers), L.J.Nugent. A large leaf and very young shoot gathered on Thursday Island, E.Cowley.* **Type:** Queensland. Cook District: Stoney Creek, undated, *L.J.Nugent s.n.* (lecto: BRI [AQ333176], *fide* Forster & Dowe 2014).
= **Deplanchea tetraphylla** (R.Br.) F.Muell., *2nd Syst. Census Austral. Pl.* 167 (1889); CHAH (2010).

Caesalpiniaceae

13. *Cassia brewsteri* var. *sylvestris* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 3: 11 (1891). **Type citation:** lacking, but cited as '*Kamerunga, Barron River, E.Cowley'* by Bailey (1902: 456). **Type:** Queensland. Cook District: Cairns, undated, *E.Cowley s.n.* (holo: BRI [AQ17718]). = **Cassia queenslandica** C.T.White, *Proc. Roy. Soc. Queensland* 50: 74 (1939).

***Notes*:** Symon (1966) included *C. brewsteri* var. *sylvestris* as a synonym of *C. queenslandica*. Amongst his selected specimens, Symon (1966: 80) listed '*E.Cowley, Redlynch (Kamerunga) Barron River: BRI'*. There is one Cowley specimen extant at BRI related to this taxon, though labelled as 'Cairns', but the citation appears to relate to this specimen.

Convolvulaceae

14. *Erycibe paniculata* var. *coccinea* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 80 (1893). **Type citation:** *I am indebted to Miss Cowley, of Kamerunga, for the ripe fruit of the above plant, which she says is of a pleasing cardinal red.* **Type:** Queensland. Cook District: Kamerunga, undated, *E.Cowley 71D* (holo: BRI [AQ354886]). = **Erycibe coccinea** (F.M.Bailey) Hoogland ex Ooststr., *Fl. Males. Ser. I* 4: 431 (1951); CHAH (2006).

Corynocarpaceae

15. *Cyanocarpus cribbiana* F.M.Bailey, *Queensland Agric. J.* 1(5): 370 (1897); *Helicia cribbiana* (F.M.Bailey) F.M Bailey, *Queensl. Fl.* 4: 1327 (1901). **Type citation:** *Mourilyan district, E.Cowley, Sept., 1897.* **Type:** Queensland. Cook District: Mourilyan district, September 1897, *E.Cowley 3* (holo: BRI [AQ320965]; iso: K). = **Corynocarpus cribbianus** (F.M.Bailey) L.S.Sm., *Proc. Roy. Soc. Queensland* 67: 31 (1956).

***Note*:** Smith (1956: 31) cited *'Mourilyan district, E.Cowley 3, Sept. 1897 – fr.*' as the type specimen. Sleumer (1955) cited the Cowley 'type' specimen at K, but not the one at BRI. In resolution, the BRI specimen represents the holotype, and the duplicate at K an isotype.

Cucurbitaceae

16. *Zehneria ejecta* F.M.Bailey, *Queensl. Fl.* 2: 699 (1900); *Melothria ejecta* (F.M.Bailey) Cogn., *Pflanzenr.* 66: 108 (1916). **Type citation:** *Thursday Island, E.Cowley (inflorescence 1893). I only received fruit in 1897.* **Type:** Queensland. Cook District: Thursday Island, May 1893, *E.Cowley 65* (holo: BRI [AQ334631]). = **Muellerargia timorensis** Cogn., *Monogr. Phan. [A.DC & C.DC]* 3: 630 (1881); Telford (1982: 188).

Cunoniaceae

17. *Weinmannia apetala* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 76 (1893); *Pseudoweinmannia apetala* (F.M.Bailey) Engl., *Nat. Pflanzenfam. [Engler & Prantl] ed. 2* 18 a: 249 (1930). **Type citation:** *Kamerunga, E.Cowley.* **Type:** Queensland. Cook District: Kamerunga, January 1892, *E.Cowley 65* (holo: BRI [AQ341025]; iso: K). = **Pseudoweinmannia lachnocarpa** (F.Muell.) Engl., *Nat. Pflanzenfam. [Engler & Prantl] ed. 2* 18 a: 249 (1930); Rozefelds & Pellow (2011: 261).

Cyperaceae

18. *Gahnia breviaristata* Benl, *Repert. Spec. Nov. Veg.* 44: 199 (1938). **Type citation:** *Australiens. North Queensland: Kamerunga, Barron River (E.Cowley, No. 33d – Typus in Hb. München, ex Hb. Queensl., Brisbane*. **Type:** Queensland. Cook District: Barron River, undated, *E.Cowley 33D* (holo: M; iso: BRI [AQ341239], MEL). = **Gahnia sieberiana** Kunth, *Enum. Pl. (Kunth)* 2: 332 (1837); CHAH (2012).

Dilleniaceae

19. *Tetracera cowleyana* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 5: 7 (1892). **Type citation:** *Herbert River, H.G. Eaton; Cairns, E.Cowley.* **Type:** Queensland. Cook District: Cairns, undated, *E.Cowley 22* (lecto: BRI [AQ341696], *fide* Forster & Dowe 2014). = **Tetracera nordtiana** var. **moluccana** (Martelli) Hoogland, *Fl. Males. Ser. I* 4: 145 (1951).

Fabaceae

20. *Kennedia exaltata* F.M.Bailey, *Queensland Agric. J.* 1(1): 79 (1897); *Kennedya* ? *exaltata* F.M.Bailey, *Comp. Cat. Queensland Pl.* 143 (1913). **Type citation:** *Scrubs of the Barron River, E.Cowley.* **Type:** Queensland. Cook District: Kamerunga, undated, *E.Cowley s.n.* (holo: BRI [AQ228870]). = **Pueraria montana** var. **lobata** (Willd.) Maesen & S.M.Almeida ex Sanjappa & Predeep, *Legumes Ind.* 288 (1992); Sanjappa (1992).

Flacourtiaceae

21. Homalium circumpinnatum F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 5: 17 (1892). **Type citation:** *Cairns, E.Cowley.* **Type:** Queensland. Cook District: Near Cairns, undated, *E.Cowley 21A* (holo: BRI [AQ342709]; iso: BM); Jessup (1982: 79).

Icacinaceae

22. '*Gomphandra polymorpha* Wight var. *6*' F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 72 (1893), *nom. illeg.* **Specimen citation:** *Scrubs of the Barron River, E.Cowley. Sept. 1893.* = **Gomphandra australiana** F.Muell., *Fragm.* 6(41): 3 (1867); Guymer (1984: 209).

***Note*:** Bailey (1893) noted: '*From the fragmentary specimens which I have of G. australiana F. v. M., the present plant seems to differ considerably both in foliage and inflorescence*'; he subsequently added '*Wood of light colour and nicely marked*' (Bailey 1913).

Lauraceae

23. Cryptocarya oblata F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 9: 11 (1894). **Type citation:** *Daintree River, E.Cowley.* **Type:** Queensland. Cook District: Daintree River, June 1894, *E.Cowley 7* (holo: BRI [AQ340529]; iso: K); Hyland (1982: 199).

24. Endiandra cowleyana F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 5: 23 (1892). **Type citation:** *Scrubs near Barron River, E.Cowley.* **Type:** Queensland. Cook District: [Barron River], undated, *E.Cowley 42* (holo: BRI [AQ340560]; iso: BM, K); Hyland (1982: 225).

25. Endiandra sankeyana F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 82 (1893). **Type citation:** *Scrubs of the Barron River, E.Cowley.* **Type:** Queensland. Cook District: Barron River, undated, *E.Cowley 81D* (holo: BRI [AQ340579]; iso: K, MEL); Hyland (1982: 247).

Lycopodiaceae

26. *Lycopodium clarae* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 7: 69. (1893); *Urostachys clarae* (F.M.Bailey) Herter ex Nessel, *Bärlappgewächse* 185 (1939); *Huperzia clarae* (F.M.Bailey) Holub, *Geobot. Phytotax.* 20(1): 71 (1985). **Type citation:** *Upper Freshwater Creek, E.Cowley.* **Type:** Queensland. Cook District: Upper Freshwater Creek, undated, *E.Cowley 29D* (holo: BRI [AQ24829]; iso: K). = **Phlegmariurus dalhousieanus** (Spring) A.R.Field & Bostock, *PhytoKeys* 20: 38 (2013).

***Notes*:** The type citation (Bailey 1893) noted E.Cowley as the collector. Later, Bailey (1902) noted that "Miss Clara Cowley" collected a specimen at Upper Freshwater Creek. Chinnock (2003) cited the holotype of *L. clarae* as "*Upper Freshwater Creek...C. Cowley*", but this is rescinded by the action of Field & Bostock (2013) who designated *E.Cowley 29* as the holotype. However, the BRI specimen appears to be composed of two elements, one the original E.Cowley collection and the other the C.Cowley collection. It is not possible to determine which is which and therefore the entire sheet has been interpreted as the type. There is some correspondence regarding this between F.M.Bailey and both E.Cowley and C.Cowley, and it is possible that C.Cowley sent Bailey material from a plant that was cultivated in the Kamerunga State Nursery shade houses. The origin of this plant was most likely the E. Cowley collection from Freshwater Creek (Field & Bostock 2013: 38).

Meliaceae

27. *Castanospora longistipitata* F.M.Bailey, *Queensl. Fl.* 1: 288 (1899); *Rhetinosperma longistipitatum* (F.M.Bailey) Radlk., *Nat. Pflanzenfam. Nachtr. 3,* 2(3): 204 (1907). **Type citation:** *Scrubs of the Barron River, E.Cowley.* **Type:** Queensland. Cook District: Near Cairns, scrubs of the Barron River, undated, *E.Cowley 8D* (holo: BRI [AQ237765]). = **Chisocheton longistipitatus** (F.M.Bailey) L.S.Sm., *Proc. Roy. Soc. Queensland* 70(5): 29 (1959); Smith (1959: 29); Mabberley & Pannell (2013: 22).

28. Dysoxylum pettigrewianum F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 5: 9 (1892) [as *Dysoxylon pettigrewianum*]. **Type citation:** *Scrubs at the base of Bellenden-Ker Range and the Barron River.* **Type:** Queensland. Cook District: Base of Bellenden Ker Range, also at the Barron River, undated, *E.Cowley* (holo: BRI [AQ23121]; iso: BM, MEL).

Note: The type collection may possibly consist of material from two locations; however, as only a single branchlet is preserved it can probably be presumed to originate from 'Base of Bellenden Ker Range' and that Cowley subsequently observed it at the 'Barron River'.

Monimiaceae

29. *Mollinedia subternata* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 5: 22 (1892). **Type citation:** *Freshwater Creek, near Cairns, E.Cowley.* **Type:** Queensland. Cook District: Cairns, Freshwater Creek, undated, *E.Cowley 42A* (holo: BRI [AQ23244]). = **Steganthera laxiflora** (Benth.) Whiffin & Foreman var. **laxiflora**, *Fl. Australia* 2: 452 (2007); Whiffin & Foreman (2007: 85).

Moraceae

30. *Ficus thynneana* F.M.Bailey, *Queensland Agric. J.* 1(3): 231 (1897). **Type citation:** *On the beach at Cairns, and locally known as the Banyan.* **Type:** Queensland. Cook District: Cairns, August 1897, *E.Cowley s.n.* (holo: BRI [AQ65667]). = **Ficus microcarpa** L.f., *Suppl. Pl.* 442 (1782).

***Note*:** Chew (1989: 39) cited the type as 'Cairns, Qld, *E.Cowley; n.v.*' based on the type citation, but did not provide details about the specimen.

Myrtaceae

31. *Eugenia kuranda* F.M.Bailey, *Queensl. Fl.* 2: 658 (1900). **Type citation:** *Johnson, Dr. Thos. L.Bancroft; Barron river, E.Cowley.* **Type:** Queensland. Cook District: Johnstone River, undated, *T.L.Bancroft R11* (lecto: BRI [AQ269987]; isolecto: MEL, *fide* Hyland 1983: 96). = **Syzygium kuranda** (F.M.Bailey) B.Hyland, *Austral. J. Bot. Suppl. Ser.* 9: 96 (1983).

***Note*:** The specimen *Cowley 63C* (syntype), from Johnstone River, is extant in BRI.

32. *Myrtus exaltata* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 77 (1893); *Austromyrtus exaltata* (F.M.Bailey) Burrett, *Notizbl. Bot. Gart. Berlin-Dahlem* 15(3): 501 (1941). **Type citation:** *Scrubs about the Barron River, the fruit used for jam-making, E.Cowley.* **Type:** Queensland. Cook District: Kamerunga, Barron River, undated, *E.Cowley 7B* (holo: BRI [AQ278628]; iso: K). = **Syzygium luehmannii** (F.Muell.) L.A.S.Johnson, *Contr. New South Wales Natl Herb.* 3(3): 99 (1962); Hyland (1983: 98).

33. *Rhodamnia trinervia* var. *spongiosa* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 7: 62 (1893). **Type citation:** *Tringilburra Creek, Bellenden-Ker Expedition. Barron River, E.Cowley.* **Type:** Queensland. Cook District: Barron River, undated, *E.Cowley 60D* (lecto: BRI [AQ44905], *fide* Snow 2007: 30). = **Rhodamnia spongiosa** (F.M.Bailey) Domin, *Biblioth. Bot.* 89: 486 (1928).

***Note*:** Snow (2007: 30) chose '*Cowley 60D'* as the lectotype, but the '*Tringilburra Creek, Bellenden Ker Expedition'* collection has not been identified or located.

Orchidaceae

34. *Spathoglottis soutteriana* F.M Bailey, *Proc. Roy. Soc. Queensland* 11: 15 (1895). **Type citation:** *Stony Creek, Cairns-Herberton Railway line. I received a leaf and single bloom in Feb. 1893, from Mr. L.J.Nugent and more perfect specimens last October from Mr. E.Cowley, of Kamerunga, and consider it to differ from others sufficient to rank as a distinct species.* **Type:** Queensland. Cook District: Kamerunga, 7 Oct. 1894, *E.Cowley 3* (lecto: BRI [AQ312003], *fide* Clements 1989: 134). = **Spathoglottis paulinae** F.Muell., *Fragm.* 6(43): 95 (1867).

***Note*:** Clements (1989) noted that the *Nugent* specimen cited in the protologue could not be located at BRI.

35. Zeuxine oblonga R.S.Rogers & C.T.White, *Proc. Roy. Soc. Queensland* 32: 121 (1921). **Type citation:** *Kamerunga (Barron River), E.Cowley; Mackay, L.J.Nugent; Daintree River, Gus. Rosenstrom.* **Type:** Queensland. Cook District: Kamerunga, Barron River, undated, *E.Cowley s.n.* (lecto: BRI [AQ369363], *fide* Clements 1989: 147).

***Note*:** Clements (1989: 147) cited the two other collections, *Nugent s.n.* and *Rosenstrom s.n.* listed in the protologue, as syntypes.

Pittosporaceae

36. Bursaria tenuifolia F.M.Bailey, *Queensl. Fl.* 1: 72 (1899). **Type citation:** *Barron River, E.Cowley: Shaw Island, Lord Lamington: Northcote, R.C.Burton; Herberton, J.F.Bailey.* **Type:** Queensland. Cook District: Shaw Island, July 1899, *Lord Lamington [as Lord Rassington]* (lecto: BRI, *fide* Cayzer *et al.* 1999: 132).

***Note*:** The collection *Cowley 70C* (syntype), from Barron River is extant in BRI.

Poaceae

37. *Panicum prenticeanum* F.M.Bailey, *Syn. Queensl. Fl.* Suppl. 3: 82 (1890); *Panicum sarmentosum* var. *prenticeanum* (F.M.Bailey) Domin, *Biblioth. Bot.* 85: 315 (1915). **Type citation:** *Harvey's Creek, Russell River, and Tringilburra Creek; very abundant on the rich scrub lands.* **Type:** Queensland. Cook District: Harveys Creek, Russell River, and Tringilburra Creek, undated, *F.M.Bailey s.n.* (holo: BRI; iso: K). = **Panicum incomtum** Trin., *Graminibus Panic. [Trinius]* 200 (1826).

***Note*:** The specimen '[Kamerunga?] *E.Cowley 45B* at BM, has been labelled as a 'type' with a duplicate at BRI. However, the type is clearly the Bailey collection. Webster (1987: 129) gave the holotype at K; however, S.T.Blake in 1971 had already annotated the BRI material (not seen by Webster) as this and the K duplicate of Bailey's should be regarded as an isotype.

Proteaceae

38. *Helicia glabrescens* C.T.White, *Proc. Roy. Soc. Queensland* 55: 81 (1944). **Type citation:** Cook District: *Barron River, E.Cowley 74B (type: Flowers), Sept. 1892 (large shrub).* **Type:** Queensland. Cook District: Barron River, September. 1892, *E.Cowley 74B* (holo: BRI [AQ317432]). = **Helicia australasica** F.Muell., *Hooker's J. Bot. Kew Gard. Misc.* 9: 22 (1857); Sleumer (1955: 16).

Rosaceae

39. *Pygeum turnerianum* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 75 (1893). **Type citation:** *For shoot, bearing male flowers, and later branches with ripe fruit, Barron River, E.Cowley. Stones of fruit, Christie Palmerston and A.Meston.* **Type:** Queensland. Cook District: Barron River, 1893, *E.Cowley s.n.* (lecto: BRI [AQ317688], *fide* Forster & Dowe 2014). = **Prunus turneriana** (F.M.Bailey) Kalkman, *Blumea* 13(1): 81 (1965).

Rubiaceae

40. Gardenia ovularis F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland 7*: 64 (1893). **Type citation:** *Johnstone River, Dr. T.L.Bancroft. Barron River, E.Cowley.* **Type:** Queensland. Cook District: Johnstone River, undated, *T.L.Bancroft s.n.* (lecto: BRI [AQ317839]; isolecto: BRI, K, MEL, *fide* Puttock 1988: 437).

***Note*:** Puttock (1988: 437) chose the Bancroft collection as the type of this name. The Cowley collection (syntype) is extant at BRI. This collection (*Cowley 71*) appears to be a mixture of elements from 1891 and Jan. 1892.

41. *Nauclea gordoniana* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 10: 22 (1895); *Neonauclea gordoniana* (F.M.Bailey) Ridsdale, *Gard. Bull., Singapore* 25: 272 (1970). **Type citation:** *Barron River, E.Cowley.* **Type:** Queensland. Cook District. Kamerunga, undated, *E.Cowley 92D* (holo: BRI [AQ433563]; iso: L). = **Neonauclea glabra** (Roxb.) Bakh.f. & Ridsdale, *Blumea* 34(1): 240 (1989).

***Note*:** Ridsdale (1970: 272) cited the specimen '*Cowley, Baron River (TYPE)*', but without further details. Later, Ridsdale (1989: 241) provided the location of the holotype at BRI, and an isotype at L.

42. *Plectronia odorata* var. *reticulata* C.T.White, *Proc. Roy. Soc. Queensland* 50: 78 (1939). **Type citation:** *Thursday Island (E.Cowley, No. 10, type of variety, flowering specimens).* **Type:** Queensland. Cook District: Thursday Island [1893], *E.Cowley 10* (holo: BRI [AQ318150]). = **Psydrax reticulata** (C.T.White) S.T.Reynolds & R.J.F.Hend., *Austrobaileya* 6(4): 855 (2004).

Sapindaceae

43. *Cupania flagelliformis* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 73 (1893). **Type citation:** '*Scrub about the Barron River, E.Cowley.* **Type:** Queensland. Cook District: Scrubs about the Barron River, undated, *E.Cowley 29B & 83D* (holo: BRI [AQ22540]). = **Cupaniopsis flagelliformis** (F.M.Bailey) Radlk., *Repert. Spec. Nov. Veg.* 20(1–5): 31 (1924); Reynolds (1984: 50).

44. *Cupania sericolignis* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 18: 11 (1892). **Type citation:** *Mulgrave River, Bellenden-Ker Expedition; scrub about the Barron River, E.Cowley.* **Type:** Queensland. Cook District: Barron River, Kamerunga, May 1892, *E.Cowley 69A* (lecto: BRI [AQ22543], *fide* Reynolds 1982: 490). = **Lepiderema sericolignis** (F.M.Bailey) Radlk., *Repert. Spec. Nov. Regni Veg.* 20(1–5): 29 (1924).

***Note*:** Reynolds (1982: 490) listed the Cowley collection as 'holo'; however, it is an effective lectotypification as she also explicitly excluded the 'Mulgrave River, Bellenden-Ker Expedtion' collection that pertains to *Guioa acutifolia*.

45. *Ratonia nugentii* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 14: 9 (1896). **Type citation:** *Freshwater Creek, Cairns, E.Cowley and L.J. Nugent.* **Type:** Queensland. Cook District: Freshwater Creek, near Cairns, August 1896, *L.J.Nugent, E.Cowley 8C* (holo: BRI [AQ22535]). = **Toechima erythrocarpum** (F.Muell.) Radlk., *Act. Congr. Bot. Amsterdam* 130 (1879); Reynolds (1985: 178).

***Note*:** It is unclear whether this collection comprises two separate portions from either collector or whether it was a co-collection.

Sapotaceae

46. *Sideroxylon dugulla* F.M.Bailey, *Queensland Agric. J.* 1(1): 80 (1897); *Sersalisia dugulla* (F.M.Bailey) Domin, *Biblioth. Bot.* 89: 509 (1928); *Pouteria dugulla* (F.M.Bailey) Baehni, *Candollea* 9: 407 (1942). **Type citation:** *Barron River, E.Cowley. Fruit eaten by natives.* **Type:** Queensland. Cook District: Barron River, May 1897, *E.Cowley KA1* (holo: BRI [AQ22565]; iso: BM, K). = **Planchonella pohlmaniana** (F.Muell.) Pierre ex Dubard, *Ann. Inst. Bot.-Geol. Colon. Marseille ser. 2* 10: 47 (1912); CHAH (2008).

Sterculiaceae

47. *Tarrietia argyrodendron* var. *macrophylla* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 9: 5 (1894). **Type citation:** *Barron River, E.Cowley.* **Type:** Queensland. Cook District: Barron River, undated, *E.Cowley 111* (holo: BRI [AQ22696]). = **Argyrodendron trifoliolatum** var. **macrophyllum** (F.M.Bailey) Burtt Davy, *Trop. Woods 51*: 19 (1937).

Note: Referenced but not typified in Kostermans (1959: 529) and Smith (1969: 19).

Table 3. Plant taxa named for Ebenezer Cowley, and his first daughter Clara Moxon (née Cowley). Currently accepted names are in bold

Aidia cowleyi Puttock [named for the type locality Cowley Beach] (Puttock 1988)
Endiandra cowleyana F.M.Bailey [named for Ebenezer Cowley]
Lycopodium clarae F.M.Bailey, synonym of ***Phlegmariurus dalhousieanus*** (Spring) A.R. Field and Bostock [named for Clara Cowley, 1st daughter of Ebenezer Cowley]
Ochrosia cowleyi F.M.Bailey [named for Ebenezer Cowley], synonym of ***Neisosperma oppositifolium*** (Lam.) Fosberg & Sachet
Tetracera cowleyana F.M.Bailey var. *cowleyana* [named for Ebenezer Cowley], synonym of ***Tetracera nordtiana*** var. ***moluccana*** (Martelli) Hoogland

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Plectranthus acariformis P.I.Forst. and *P. geminatus* P.I.Forst. (Lamiaceae): new species from south-east Queensland

Paul I. Forster

Summary

Forster, P.I. (2014). *Plectranthus acariformis* P.I.Forst. and *P. geminatus* P.I.Forst. (Lamiaceae): new species from south-east Queensland. ***Austrobaileya* 9(2): 279–291**. *Plectranthus acariformis* and *P. geminatus* are newly described and illustrated: both are endemic to south-east Queensland. The former is currently known from a single population on trachyrhyolite in Noosa National Park near Coolum on the Sunshine Coast whereas the latter occurs in several localities associated with basalt and rhyolite derived from the Mt Warning caldera in the Lamington Plateau and Numinbah Valley.

Key Words: Lamiaceae, *Plectranthus*, *Plectranthus acariformis*, *Plectranthus geminatus*, Australia flora, Queensland flora, Noosa National Park, Lamington Plateau, Numinbah Valley, new species, taxonomy, conservation status

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Introduction

The genus *Plectranthus* L.Herit. is diverse in Australia with over 40 recognised species (Forster 2011, 2014). In south-east Queensland (equivalent to the Southeast Queensland bioregion, *cf.* Sattler & Williams 1999), 11 native species are currently recognised with five of these (*P. fragrantissimus* P.I.Forst., *P. habrophyllus* P.I.Forst., *P. leiperi* P.I.Forst., *P. omissus* P.I.Forst. and *P. torrenticola* P.I.Forst.) endemic. Hypotheses on speciation in the genus in Australia have been previously outlined (Forster 2011) and it is to be expected that further taxa will be newly discovered in the region and elsewhere.

Two additional species are described in this paper. One of these (*P. acariformis* P.I.Forst.) has a highly restricted distribution and is known from a single locality which may indicate that it is an example of recent speciation. The other species (*P. geminatus* P.I.Forst.) is more widespread and known from five localities.

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Materials and methods

Fieldwork was undertaken in south-east Queensland to procure fresh material for specimens and cultivation enabling observation of variation in phenology. The subsequent descriptions and observations are based on these recent collections and other historical collections in the Queensland Herbarium (BRI).

Taxonomy

Plectranthus acariformis P.I.Forst., **sp. nov.**; With affinity to *P. parviflorus* Willd. but differing in the thickened base to the stems (versus a distinct rounded tuber), the distinctive glandular trichomes with enlarged bases that impart crenate to crenulated margins to the floral bracts and the greater number of flowers in the verticillasters (16–24 versus up to 10). **Typus:** Queensland. Moreton District: Noosa National Park, Mt Emu (Peregian) summit, 5 February 2014, *P.I. Forster PIF40678 & G. Leiper* (holo: BRI [2 sheets + spirit]; iso: K, MEL, NSW, US *distribuendi*).

Erect herb to 50 cm high; foliage scentless when crushed, not clammy; non-glandular and glandular trichomes uncoloured, non-glandular trichomes with prominent raised

bases, sessile glands 8-celled, orange. Roots thickened-tuberous to fibrous. Stems square, erect to straggling, fleshy, with stringy fibres, the lower parts up to 7 mm diameter and noticeably thickened (although not with a rounded tuber), pink-purple to pink-green, upper parts with persistent indumentum, non-glandular trichomes sparse to dense, retrorse, 6–10-celled up to 1 mm long, glandular trichomes absent or scattered to sparse, very short < 0.1 mm long, sessile glands absent. Leaves discolorous, petiolate; petioles 5–25 × 1.5–3 mm, channelled on top, non-glandular trichomes dense and shaggy, retrorse, 4–10-celled up to 1 mm long, glandular trichomes absent or scattered to sparse, very short < 0.1 mm long, sessile glands absent or occasional; laminae lanceolate-ovate to ovate, fleshy, strongly keeled, 10–45 × 5–42 mm, crenate with 6–8 teeth up to 4 mm long on each margin, of similar length along margin, secondary teeth poorly developed; tip acute; base obtuse to rounded; upper surface mid-green and with a hoary silver frosting from indumentum, veins impressed, non-glandular trichomes dense, antrorse to somewhat divaricate, 4–10-celled up to 1 mm long, glandular trichomes and sessile glands absent; lower surface pale green and with a hoary silver frosting from indumentum, veins strongly raised, non-glandular trichomes dense and shaggy (interlocking), divaricate, 6–10-celled up to 0.8 mm long, glandular trichomes generally absent or a few 'micro' trichomes on veins that are < 0.1 mm long, sessile glands scattered and deeply recessed. Inflorescence up to 300 mm long, usually single or with 1 or 2 side branches; axis square in cross-section, pink, non-glandular trichomes sparse to dense, divaricate, 4–10-celled up to 1 mm long, glandular trichomes absent, or sparse and minute (< 0.3 mm long), sessile glands absent; bracts obovate-rhomboid, 2.2–2.8 × 1.3–1.9 mm, ecomose, margins irregularly crenate to crenulate due to enlarged bases of glandular trichomes, non-glandular trichomes sparse, divaricate, 4–10-celled up to 0.9 mm long, glandular trichomes scattered and very short (< 0.3 mm long), sessile glands occasional to scattered; verticillasters 16–24-flowered, 5–10 mm apart; pedicels 2.5–3 × *c.* 0.2 mm, non-glandular trichomes sparse, antrorse to divaricate, 4–8-celled up to 0.5 mm long, glandular trichomes scattered to sparse, very short (< 0.2 mm long), sessile glands absent. Flower calyces 2.6–2.8 mm long, non-glandular trichomes sparse, antrorse to divaricate, 4–8-celled up to 0.5 mm long, glandular trichomes sparse and very short (< 0.2 mm long), sessile glands sparse. Corolla 9–11.5 mm long, lilac-purple; tube 4.5–5.5 mm long, weakly curved at 25–30° 1.5–2 mm from the base, slightly inflated upwards, non-glandular trichomes absent or scattered, 2-celled and very short (< 0.1 mm long), glandular trichomes and sessile glands absent; upper lobes suborbicular, erect to reflexed, 1.9–2.3 × 1.8–2.3 mm, non-glandular trichomes sparse, divaricate, 2–4-celled up to 0.3 mm long, glandular trichomes absent, sessile glands sparse; lateral lobes oblong, 1.3–1.5 × 0.7–0.8 mm, glabrous; lower lobe oblong-ovate, 5–5.5 × 5–5.2 mm, non-glandular trichomes sparse, divaricate, 2–4-celled up to 0.3 mm long, glandular trichomes absent, sessile glands sparse; filaments filiform, 8–9 × *c.* 0.2 mm, lilac, fused for 3–4 mm from the base; anthers *c.* 0.4 × 0.3 mm; style filiform, 8–9 × *c.* 0.2 mm, lilac, bifid for *c.* 0.4 mm. Fruit calyces 4–4.6 mm long; upper lobe broadly ovate, 2–2.2 × 2–2.2 mm; lateral lobes lanceolate, 1.5–1.8 × 0.6–0.8 mm; lower lobes lanceolate-falcate, 2–2.5 × *c.* 0.4 mm. Nutlets ± circular in outline, compressed flattened globose, 0.8–0.9 mm wide, 0.4–0.5 mm thick, brown, weakly verrucose. **Figs. 1–5.**

***Additional specimens examined*: Queensland.** Moreton District: Mt Peregian, Coolum (cult. The Gap, Brisbane), Jan 1957, *Blake 20077* (BRI); Noosa NP, Mt Emu (Peregian) (cult. Beenleigh), Jan 2014, *Leiper s.n.* (BRI [AQ837023], NSW).

***Distribution and habitat*:** *Plectranthus acariformis* is currently known only from Mt Emu (Peregian), a small volcanic plug overlooking the Pacific Ocean on the Sunshine Coast in south-east Queensland. Plants of this species were common at the summit of the mountain (small hill in reality) in low heathland on fine grained trachyrhyolite (Willmott 2004) rock outcrops. These peraluminous rhyolites are also found on Mt

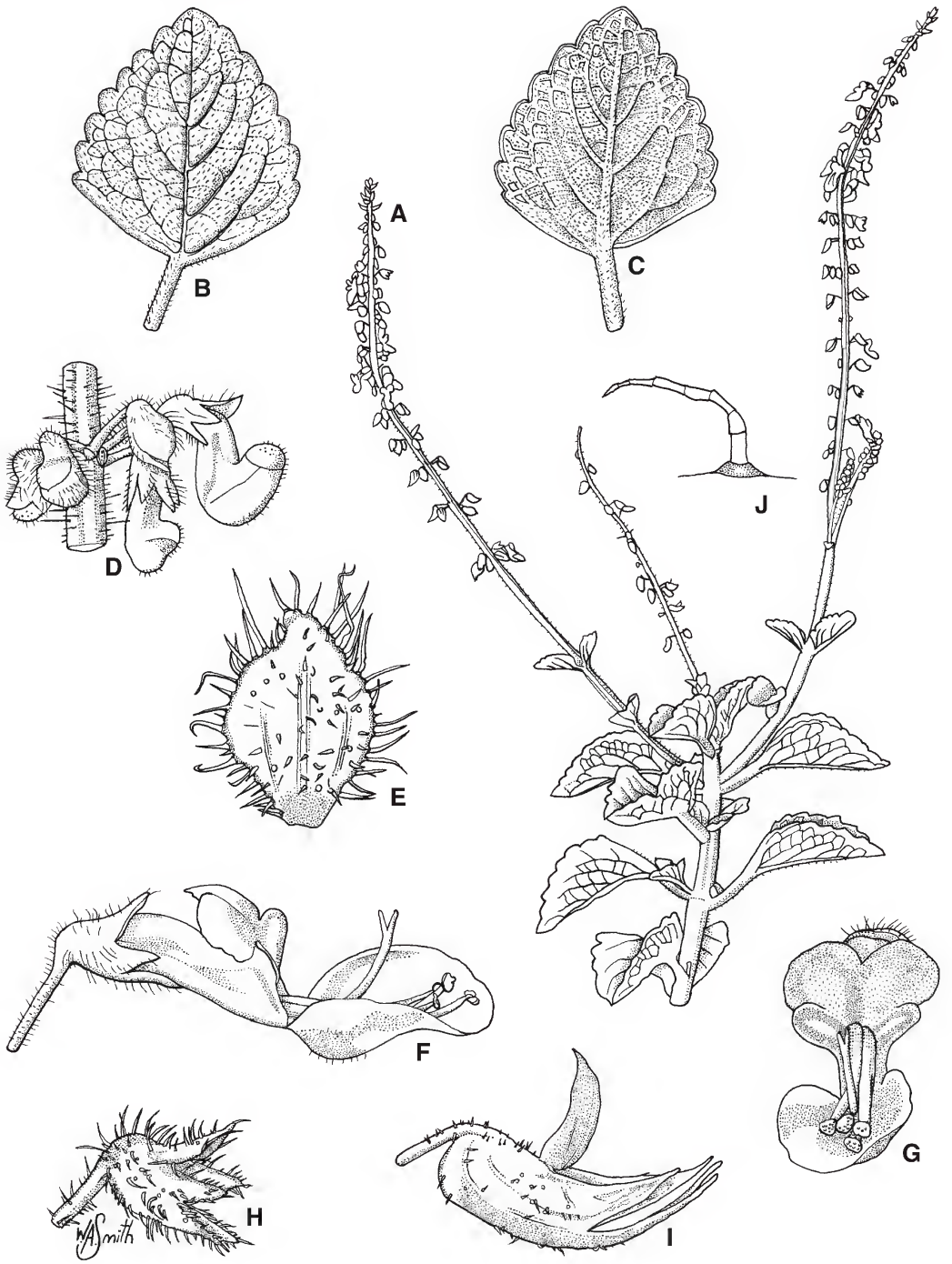

Fig. 1. ***Plectranthus acariformis***. A. habit of flowering stem ×0.5. B. adaxial leaf surface ×1. C. abaxial leaf surface ×1. D. verticillaster with buds ×4. E. floral bract ×12. F. lateral view of flower ×6. G. front view of flower ×6. H. lateral view of flower pedicel and calyx ×8. I. lateral view of fruiting pedicel and calyx ×8. J. non-glandular hair from foliage demonstrating enlarged basal cell ×36. All from *Leiper s.n.* (BRI [AQ837023]). Del. W. Smith.

Fig. 2. ***Plectranthus acariformis***. Plants in habitat at Mt Emu (*Forster PIF40678 & Leiper*). Photo: G. Leiper.

Fig. 3. ***Plectranthus acariformis***. Detail of foliage from plants at Mt Emu (*Forster PIF40678 & Leiper*). Photo: G. Leiper.

Fig. 4. ***Plectranthus acariformis***. Partial inflorescence with flowers from plants at Mt Emu (*Forster PIF40678 & Leiper*). Photo: G. Leiper.

Fig. 5. ***Plectranthus acariformis***. Thickened (non-tuberous) stems bases from plants at Mt Emu (*Forster PIF40678 & Leiper*). Photo: G. Leiper.

Tinbeerwah in the Glasshouse Mountains and are Cenozoic in origin (Cohen *et al.* 2007).

***Notes*:** *Plectranthus acariformis* was first collected by either Stan Blake or one of his collectors prior to January 1957 with the material cultivated by Blake in his Brisbane garden. The population of plants was rediscovered by Glenn Leiper sometime prior to January 2014 and is the only species of this genus found to date on Mt Emu. Both *P. graveolens* R.Br. and *P. parviflorus* have been collected from the nearby Mt Coolum that has similar rock outcrops; however, these are dominated by comendite (peralkaline rhyolite) (Willmott 2004; Cohen *et al.* 2007). The two hills are separated by 6 km of dissimilar habitat of lowland heathlands and swamps. *Plectranthus acariformis* is quite dissimilar to primary hybrids of these two species; however, the possibility that it is a result of hybridisation followed by polyploidy requires investigation. This mode of speciation is now known to be increasingly common in many plant groups (Soltis *et al.* 2003; Hegarty & Hiscock 2004; Mallett 2007) and would support the hypothesized patterns of diversification in the Australian taxa of this genus (Forster 2011).

Mt Emu may represent a minor centre of localised speciation given the presence of other endemics or near endemics, such as the tetraploid *Allocasuarina emuina* L.A.S.Johnson (Lamont *et al.* 2012). These authors also concluded that Mt Emu hosted refugial populations of many heathland species during Pleistocene interglaciations when the surrounding coastal plain was inundated. In glacial periods during the Pleistocene or into the recent Holocene and present, the area surrounding Mt Emu would have mainly supported low dunefields (Lees 2006) and swamps, neither comprising suitable habitats for this *Plectranthus*. Given the apparent restriction of *Plectranthus acariformis* to Mt Emu it can also be hypothesised that the species is an example of incipient speciation, but where apart from localised dispersal, range expansion has not yet occurred, unlike the case of *Allocasuarina emuina*. This also fits well with the concepts and theories of Levin (2000) whereby every species has to begin somewhere in space and time.

Other *Plectranthus* species from Queensland that appear to be 'stuck on a rock' at their putative point of origin include *P. actites* P.I.Forst., *P. arenicola* P.I.Forst., *P. bipartitus* P.I.Forst., *P. cyanophyllus* P.I.Forst., *P. insularis* P.I.Forst., *P. minutus* P.I.Forst., *P. splendens* P.I.Forst. and *P. thalassoscopicus* P.I.Forst. In some cases (*P. bipartitus*, *P. splendens*) the 'rock' in question is an inselberg and there are definitely multiple subpopulations ('islands on islands' *cf.* Porembski *et al.* 2000); in others on inselbergs this is still unknown (*P. actites*, *P. cyanophyllus*, *P. minutus*). For the remaining species (*P. arenicola*, *P. insularis*, *P. thalassoscopicus*) the available habitat (rock platforms or small outcrops) is much smaller and can be measured in a handful of hectares or a few hundred square metres. Further targeted field collections may well negate these observations; however, in most instances suitable habitat is lacking or geographically well removed.

Plectranthus acariformis differs from *P. parviflorus* in a number of characters, most notably the thickened but non-tuberous base (**Fig. 5**) to the stems (versus formation of a distinct rounded tuber), the distinctive glandular trichomes with enlarged bases that impart crenate to crenulated margins to the floral bracts and the greater number of flowers in the verticillasters (16–24 versus up to 10).

***Conservation status*:** This species occurs in a southern section of Noosa National Park; however, there are several threatening processes that are currently affecting it. Mt Emu is surrounded by housing developments and is increasingly a popular small hill for people to climb with a number of existing rough tracks from the base to the summit. Recently one of these has been 'upgraded' to enable vehicle access to the summit; in the process several populations of cryptic and geographically restricted ground orchids have been severely impacted with many plants destroyed. The localised population of *Plectranthus acariformis* is restricted to the very summit of the hill (**Fig. 2**) where

most of the tracks intersect and where there is repeated trampling or disturbance of the vegetation. The *Plectranthus* appears to have been trampled out or cleared from the tracks and 'sitting perches' at the summit, but persists abundantly in crevices and amongst boulders that are too rugged for most casual visitors to wander over.

Given the hypothesised incipient speciation of this species, it is likely that there is little genetic variation present in the population; indeed it is likely that most individuals (or clumps) are clonal in origin.

An appropriate conservation status (IUCN 2001) for *Plectranthus acariformis* is **Endangered** based on the criterion D.

***Etymology*:** The specific epithet is derived from the Latin noun *acarus* which is derived from Greek *ákari* (mite) and the Latin *–formis* (like) and is a fanciful allusion to the form of the floral bracts in this species.

Plectranthus geminatus P.I.Forst., **sp. nov.** Allied to *P. caldericola* P.I.Forst. but differs in the stem bases being conspicuously thickened-tuberous, foliage that is ± scentless and with non-glandular indumentum in two distinct series (versus not), the laminae are cordate-ovate (versus broadly ovate to almost lobate) with 10–14 teeth per margin (versus 7–9), the floral bracts are broadly orbicular-reniform to orbicular-obovate (versus broadly-ovate to obovate) and the corolla tube is abruptly curved (versus weakly). **Typus:** Queensland. Moreton District: Lamington National Park, Cainbable Falls, 27 February 2014, *P.I. Forster PIF40722 & G. Leiper* (holo: BRI [2 sheets + spirit]; iso: K, MEL, NSW *distribuendi*).

Erect to decumbent subshrub (rarely a herb) to 100 cm high; foliage ± scentless when crushed, somewhat clammy; non-glandular and glandular trichomes uncoloured, sessile glands 4 or 8-celled, orange-red. Roots thickened-tuberous, fleshy-fibrous. Stems square, erect to straggling, fleshy, easily snapped, the lower parts up to 7 mm diameter and noticeably thickened forming weak tubers from which reshooting occurs annually, pink-purple; upper parts with persistent indumentum, non-glandular trichomes sparse and shaggy, 2-seriate, weakly divaricate (mainly held at 90° to stem), longer trichome series 8–12-celled up to 4 mm long, shorter trichome series 4–6-celled up to 0.4 mm long, glandular trichomes dense, uniseriate, very short (< 0.1 mm long) although occasionally up to 0.7 mm long, sessile glands absent or rarely scattered to dense. Leaves discolorous, petiolate; petioles 8–55 × 1.5–3 mm, channelled on top, pink-purple, non-glandular trichomes sparse and shaggy, 2-seriate, weakly divaricate (mainly held at 90° to stem), longer trichome series 8–12-celled up to 4 mm long, shorter trichome series 4–6-celled up to < 0.5 mm long, glandular trichomes moderately dense, generally very short (< 0.2 mm long) although up to 0.7 mm long on occasion, sessile glands 8-celled, dense; laminae cordate-ovate, fleshy, keeled, 20–65 × 15–60 mm, crenate with 10–14 teeth up to 4 mm long on each margin, of similar length along margin, secondary teeth poorly developed; tip acute; base subcordate to truncate; upper surface somewhat glossy olive-green, veins impressed, velutinous, non-glandular trichomes moderately dense, 2-seriate, long trichome series divaricate, 8–10-celled and 1–4 mm long, short trichome series divaricate, 4–6-celled up to 0.8 mm long, glandular trichomes ± sessile (< 0.1 mm long), sessile glands dense, 8-celled or a mixture of 4 and 8-celled; lower surface paler green to silver-green and with a hoary silver frosting from indumentum, veins strongly raised, non-glandular trichomes dense, 2-seriate, divaricate, long trichome series 8–12-celled and 1.8–3 mm long, short trichome series 4–6-celled and < 0.5 mm long, glandular trichomes scattered, ± sessile and < 0.1 mm long, sessile glands dense, 4 and 8-celled. Inflorescence up to 120 mm long, usually single or with 1 or 2 side branches, pedunculate for up to 16 mm; axis square in cross-section, pink-purple, strongly channelled, non-glandular trichomes dense, 2-seriate, divaricate, long trichome series 8–14-celled up to 3 mm long, short trichome series 4–6-celled and < 0.5 mm long, glandular trichomes moderately dense, very short (< 0.4 mm long), sessile glands sparse

to moderately dense, 4-celled; bracts broadly orbicular-reniform to orbicular-obovate, 1.8–2.2 × 1.8–3.5 mm, initially somewhat comose, non-glandular trichomes sparse, 2-seriate, divaricate to somewhat antrorse, long trichome series 8–14-celled up to 2.5 mm long, short trichome series 4–6-celled up to 0.4 mm long, glandular trichomes absent, sessile glands moderately dense, 4 and 8-celled; verticillasters 10–12-flowered, up to 5 mm apart; pedicels 1.8–2 × *c.* 0.2 mm, non-glandular trichomes occasional to sparse, 2-seriate, divaricate, long trichome series 8–14-celled up to 1 mm long, short trichome series 4–6-celled and < 0.3 mm long, glandular trichomes dense, very short (< 0.1 mm long), sessile glands absent or occasional and 4 or 8-celled. Flower calyces 1.5–1.6 mm long, non-glandular trichomes dense and shaggy, 2-seriate, divaricate to horizontal at 90° to tube, long trichome series 8–14-celled up to 2 mm long, short trichome series 4-6-celled and < 0.5 mm long, glandular trichomes occasional and very short (< 0.1 mm long), sessile glands dense, 4 or 8-celled. Corolla 7.5–10 mm long, lilac-purple; tube 3.6–5 mm long, abruptly curved at 40–80° 1.8–2 mm from the base, slightly inflated upwards, glabrous; upper lobes suborbicular, erect to reflexed, 1.5–1.8 × 1.5–1.8 mm, non-glandular trichomes sparse, divaricate, 8–14-celled up to 2 mm long, glandular trichomes absent, sessile glands occasional, 4-celled; lateral lobes oblong, 1.2–1.3 × 0.7–0.8 mm, glabrous, purple and centrally edged with white; lower lobe broadly ovate, 3.5–5 × 3.2–4.5 mm, non-glandular trichomes sparse, divaricate, 2–4-celled and < 0.3 mm long, glandular trichomes absent, sessile glands scattered, 4 or 8-celled; filaments filiform, 7–11 × *c.* 0.2 mm, lilac, fused for 3–3.5 mm from the base; anthers *c.* 0.4 × 0.3 mm; style filiform, 9–10 × *c.* 0.2 mm, lilac, bifid for *c.* 0.4 mm. Fruit calyces 2.5–2.7 mm long; upper lobe oblong-ovate, 0.8–0.9 × 0.8–0.9 mm; lateral lobes lanceolate-falcate, 1–1.2 × 0.5–0.6 mm; lower lobes lanceolate-falcate, 1.5–1.7 × 0.5–0.6 mm. Nutlets flattened convex, 0.7–0.8 mm long, 0.7–0.8 mm wide, 0.5–0.6 mm thick, glossy brown, weakly verrucose. **Figs. 6–10.**

***Additional specimens examined*: Queensland.** Moreton District: Canungra to Mt Tamborine Road, Feb 2014, *Forster PIF40715 & Leiper* (BRI, MEL); Lamington NP, near Plum Pudding, Feb 2014, *Forster PIF40716 & Leiper* (BRI, MEL); cult. Beenleigh (ex Numinbah Valley, S of Chesters Road), Feb 2014, *Leiper s.n.* (BRI [AQ837024]); Numinbah Valley, S of Chesters Road, Feb 2014, *Forster PIF40692 & Leiper* (BRI, K, MEL, NSW); Cainbable cliffs, Lamington NP, S of Canungra, Jan 2000, *Bean 15967A* [*& Leiper*] (BRI); Lamington NP, Pats Bluff, Mar 2014, *Forster PIF40758 & Leiper* (BRI).

***Distribution and habitat*:** *Plectranthus geminatus* has a relatively small area of occurrence from south of Canungra to the northern parts of the Lamington Plateau (Sarabah Range, western cliffs) in south-east Queensland (**Map 1**). Three populations (*PIF40716*, *PIF40722* and *PIF40758*) have been found on rock outcrops or platforms derived from north-westerly basalt flows (Hobwee basalts of the Lamington Group) from the Tweed or Mt Warning Shield Volcano caldera (Stevens 1970; Willmott 2004) and are generally immediately adjacent to grassy woodland dominated by eucalypts (e.g. *Eucalyptus banksii* Maiden and *E. quadrangulata* H.Deane & Maiden or *E. crebra* F.Muell. and *E. melliodora* A.Cunn. ex Schauer). Two populations (*PIF40692* and *PIF40715*) occur on small rhyolite outcrops (Binna Burra rhyolites) derived from the same volcano (Willmott 2004) with associated grassy woodland dominated by eucalypts (e.g. *Corymbia intermedia* (R.T.Baker) K.D.Hill & L.A.S.Johnson, *Lophostemon confertus* (R.Br.) Peter G.Wilson & J.T.Waterh. or *E. carnea* R.T.Baker and *E. tereticornis* Sm.). These rock outcrops or platforms are often small in individual extent (e.g. populations sampled by *PIF40692*, *PIF40715*, *PIF40716*), though some are much larger (*PIF40722* & *PIF40758*) but tend to be mainly precipitously vertical in their entirety and thus difficult to access. Soils are skeletal to non-existent and the plants grow mainly in humus or leaf litter that has accumulated in crevices or flatter areas. At some localities, populations of *P. graveolens* are close by or occasional plants are intermingled with those of *P. geminatus.*

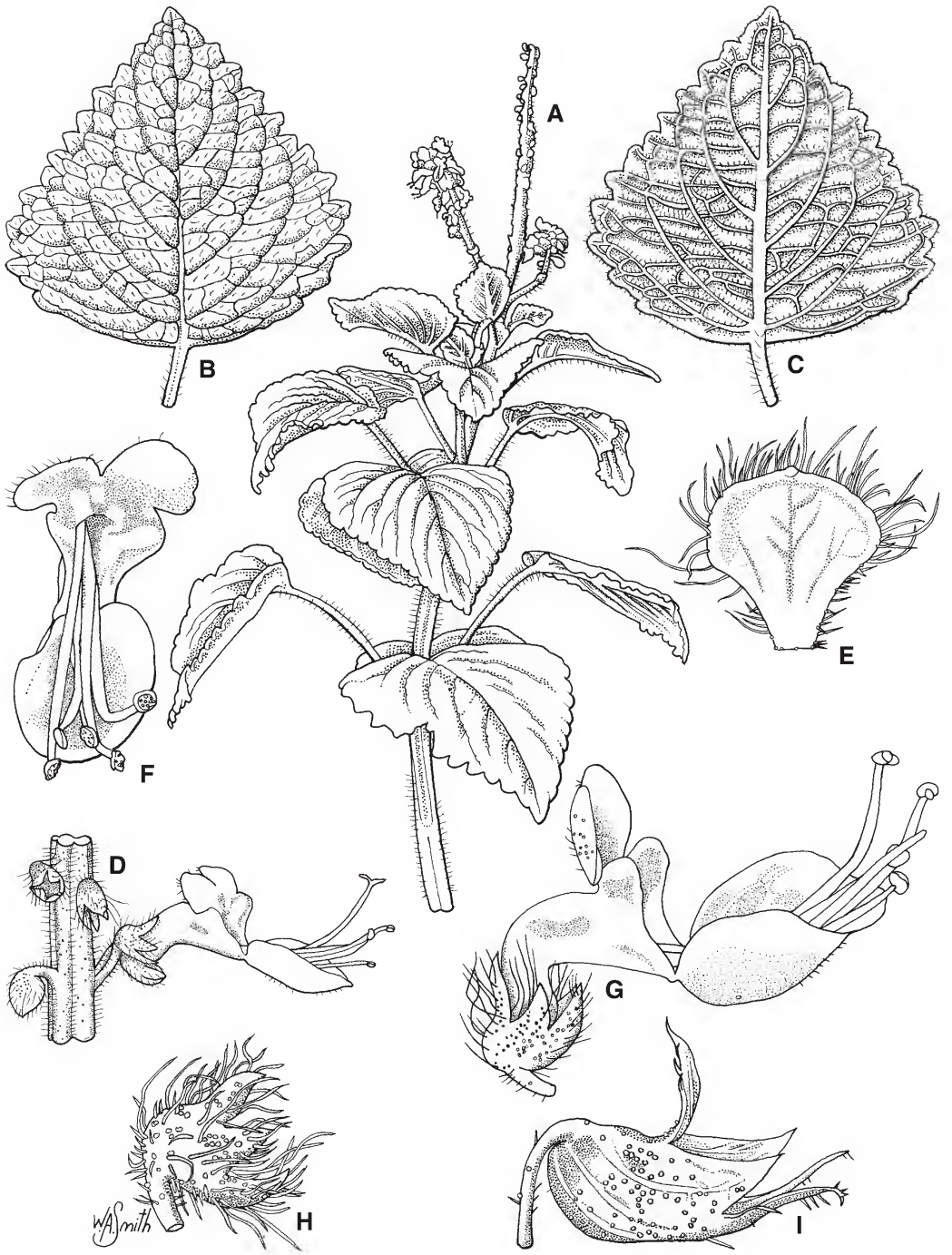

Fig. 6. ***Plectranthus geminatus.*** A. habit of flowering stem ×0.5. B. adaxial leaf surface ×1. C. abaxial leaf surface ×1. D. part of rhachis showing channelling and part verticillasters ×4. E. floral bract ×8. F. front view of flower ×8. G. lateral view of flower ×8. H. lateral view of flower calyx ×12. I. lateral view of fruit calyx ×12. All from *Leiper s.n.* (BRI [AQ837024]). Del. W. Smith.

Fig. 7. ***Plectranthus geminatus***. Habit of plants in the Numinbah Valley (*Forster PIF40692 & Leiper*). Photo: G. Leiper.

Fig. 8. ***Plectranthus geminatus***. Thickened tuberous base to stems of plants from Cainbable Falls (*Forster PIF40722 & Leiper*). Photo: G. Leiper.

Fig. 9. ***Plectranthus geminatus***. Foliage demonstrating dense sessile orange-red glands from plants in the Numinbah Valley (*Forster PIF40692 & Leiper*). Photo: G. Leiper.

***Notes*:** *Plectranthus geminatus* was first collected by Tony Bean and Glenn Leiper at Cainbable cliffs in 2000. The locations of some of the other populations were communicated to Glenn Leiper by Bruce Dalyell and collections made from these in February 2014.

Plectranthus geminatus is unique in a number of character states, notably the dense covering of orange-red sessile glands that impart a reddish look to the foliage, the pronounced biseriate nature of the dense and shaggy non-glandular indumentum on most foliage parts and the broadly orbicular-reniform to orbicular-obovate floral bracts. There are obvious gross morphological affinities between this species and *P. caldericola* P.I.Forst. from adjacent New South Wales, the latter occurs on porphyritic basalts (Forster 2011). That species by comparison is generally more decumbent, lacks the noticeably thickened stem bases, has a faint 'lemony' scent to the crushed foliage, the non-glandular indumentum is not in two distinct series, the laminae are broadly ovate to almost lobate (versus cordate-ovate) with 7–9 teeth per margin (versus 10–14), the floral bracts are broadly orbicular-reniform to orbicular-obovate (versus broadly-ovate to obovate) and the corolla tube is weakly curved (versus abruptly).

***Conservation status*:** It is likely that continued exploration of suitable habitat for this species in the general area of occurrence will reveal further populations. Some of the known populations (*PIF40692 & PIF40715*) are in habitats that are greatly disturbed and besieged by alien weeds such as *Bidens pilosa* L., *Ageratum houstonianum* Mill., *Ageratina adenophora* (Spreng.) R.M.King & H.Rob. and *Lantana camara* L. The three populations that are present in Lamington National Park are currently in good condition, though their location makes them somewhat vulnerable to occasional trampling from bush walkers and rock climbers. A suggested conservation coding is **Vulnerable** based on the criterion D2 (IUCN 2001).

Fig. 10. ***Plectranthus geminatus***. Inflorescence with flowers from plants at Pat's Bluff (*Forster PIF40758 & Leiper*). Photo: G. Leiper.

Plectranthus geminatus joins a special group of localized endemics from the northwest part of the Mt Warning caldera (primarily the Lamington Plateau and footslopes in Queensland). Other endemic vascular plant species include *Rhizanthella omissa* D.L.Jones & M.A.Clem. and *Uromyrtus lamingtonensis* N.Snow & Guymer from shrubland on basalt or rhyolite, *Podolepis monticola* R.J.Henderson and *Westringia rupicola* S.T.Blake from basalt and rhyolite cliff faces and rock outcrops and *Antrophyum austroqueenslandicum* D.L.Jones from rainforest.

***Etymology*:** The specific epithet is from the Latin word *geminatus* (double) and alludes to the biseriate nature of the non-glandular indumentum on the foliage.

Acknowledgements

I am very grateful to Glenn Leiper for his assistance with location of populations and photographing of material. Artwork was undertaken by Will Smith.

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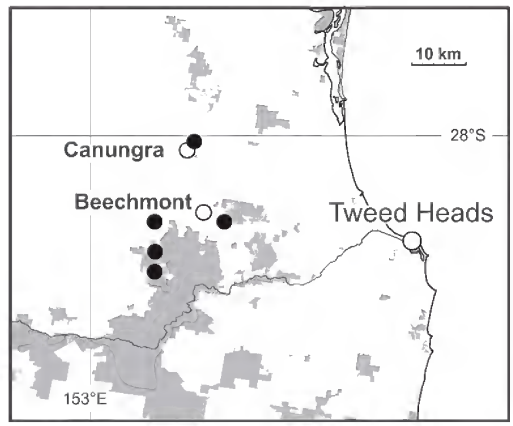

Map 1. Distribution of *Plectranthus geminatus* ● in south-east Queensland.

Six new species of *Bonamia* Thouars. (Convolvulaceae) from northern Australia

R.W. Johnson†

Summary

Johnson, R.W. (2014). Six new species of *Bonamia* Thouars. (Convolvulaceae) from northern Australia. ***Austrobaileya* 9(2): 292–310**. *Bonamia fruticosa* R.W.Johnson, *B. longipilosa* R.W.Johnson, *B. multiflora* R.W.Johnson, *B. pilbarensis* R.W.Johnson, *B. toniae* R.W.Johnson and *B. wilsoniae* R.W.Johnson are described as new and illustrated. Notes on their distribution, including maps, habitat, phenology and affinities are given.

Key Words: Convolvulaceae, *Bonamia*, *Bonamia* section *Breweria*, *Bonamia fruticosa*, *Bonamia longipilosa*, *Bonamia multiflora*, *Bonamia pilbarensis*, *Bonamia toniae*, *Bonamia wilsoniae*, Australia flora, new species, taxonomy

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Introduction

Bonamia Thouars is a predominantly pantropical genus of over 60 species. The genus was established in 1804, based on a Madagascan species. Brown (1810) described the genus *Breweria* R.Br., comprising three Australian species, *B. linearis* R.Br., *B. media* R.Br. and *B. pannosa* R.Br. and Mueller (1859) added a further species, *B. rosea* F.Muell. Hallier (1893) united these two genera. Aside from *B. dietrichiana* Hallier f., all Australian species belong to *Bonamia* Section *Breweria* (R.Br.) Myint, characterised by glabrous seeds, shorter peduncles and pedicels, smaller corollas and smaller leaves.

Myint (1968) published an account of the Australasian species of *Bonamia*, describing a new species *B. oblongifolia* Myint. Myint & Ward (1968) revised the genus *Bonamia* worldwide recognising 45 species. Since then three new species from Australia were described by Johnson (1987). Further study in preparing a generic treatment for the *Flora of Australia* has now revealed a further six undescribed species that are diagnosed and illustrated here.

Materials and methods

This work is based on herbarium specimen collections in BRI, DNA and PERTH, with some additional material from NSW and CANB. All specimens cited in this revision have been examined unless indicated otherwise by '*n.v*'. Measurements of leaves and bracts were made from dried herbarium specimens; measurements of floral parts were made from material preserved in spirit or reconstituted with boiling water.

The corolla is sympetalous and mostly funnel-shaped. The length of the corolla and the diameter of the limb are difficult to ascertain on herbarium specimens as the corolla is flattened during pressing. The length of the flattened and dried corolla approaches the petal length and it is for this reason that petal length is given in the species descriptions.

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Taxonomy

1. Bonamia fruticosa R.W.Johnson **sp. nov.**, similis *B. pannosae* et *B. multiflorae* autem ambobus capsulis seminibus antherisque magno necnon sepalis comparate latioribus quam eis *B. multiflorae* differt. **Typus:** Western Australia. vicinity of Cone Hill, Cape Domett, 22 March 1978, *T.G. Hartley 14759* (holo: CANB; iso: DNA, PERTH).

Many stemmed **perennial** shrub to 50(200) cm with erect, ascending and prostrate branches, densely hairy, pannose, grey-green; hairs biramous with spreading to erect arms 0.5–1.5 mm long. **Leaves** simple, petiolate; **petiole** 2–15(–25) mm long, 0.2–0.4(–0.5) times as long as blade; **blade** ovate to broadly ovate, ovate-oblong, 16–38(–70) mm long, 9–28(–45) mm wide, length:breadth ratio 1.2–2.4, apex acute to rounded or slightly acuminate, mucronulate, base cuneate, rounded or obtuse, rarely shallowly cordate; with a midrib and 3–5 pair of secondary veins; densely hairy to pannose on both sides, hairs with ascending arms, 0.4–1 mm long (rarely longer). **Inflorescence** axillary, cymose, with 1–5 flowers; **peduncle** ± absent to 0.5 mm long; **bracts** linear, 3–6 mm long, 0.5–0.8 mm wide, densely hairy, persistent; **pedicel** 0.5–2 mm long. **Outer sepals** ovate, broadly ovate to deltoid, 8–14 mm long, 4.3–8 mm wide, slightly longer and broader in fruit, length:breadth ratio 1.2–2.2, acute or slightly acuminate, rounded to obtuse or acute at the base, densely hairy; **inner sepals** narrowly ovate to ovate, 7–12 mm long, 2.3–5 mm wide, slightly larger in fruit, length:breadth ratio 1.6–3.7, acute or acuminate, truncate to sub-cordate at the base, densely hairy along spine and tip with a hyaline basal margin. **Corolla** funnel-shaped, 6–10 mm long, 20–25 mm diameter, blue to purple; **petals** 10–16 mm long, 7–12 mm wide at limb, rounded, emarginate, apiculate; mid-petaline bands hairy for 5.5–10 mm from tip. **Stamens** 5; filaments unequal in length, adnate for 2–3.5 mm from base of corolla tube, free for 3.5–8 mm, fused-base winged, with tubercles and hairs to 0.25 mm long above and below the point of attachment; **anthers** oblong to ovate-oblong, 2.1–2.8 mm long 0.7–1 mm wide, rounded, emarginate at the apex, sagittate, with basal lobes 0.5–1 mm long. **Ovary** oblong-globular, on a small disk, 2-locular, 1.2–2 mm long, densely hairy with erect hairs mainly confined to the upper half; **styles** 2, unequal, 5.3–8 mm long, connate in the lower 1–3.5 mm, glabrous, each with a sub-globose capitate stigma. **Capsule** ovoid, 7–8 mm long, 6–7.5 mm diameter, with a tuft of erect hairs to 1.5 mm long at the tip, circumscissile and 4-valved; **seeds** 4–5.5 mm long, 2.9–3.5 mm across, glabrous, brown to black, wingless or with narrow wing (<0.1 mm wide) or low tubercules one margin. **Figs. 1, 2A, 3E–H.**

***Additional specimens examined*: Western Australia**. WSW of Cape Londonderry, Aug 1975, *George 13389* (PERTH); Cape Domett, N of Wyndham, Jun 2003, *Kenneally 11889* (PERTH); vicinity of Cone Hill, Cape Domett, Mar 1978, *Hartley 14759* (CANB, DNA, PERTH); 7 km W of Mitchell Plateau turnoff from Gibb River – Mitchell Plateau Road, May 1981, *Tracey 13918* (BRI); King Edward River crossing on Mitchell Plateau Road, Jun 1984, *Craven 8449* (CANB); 80 km N of Kununurra, E side of main road, Mar 1992, *Mitchell 2136* (BRI, PERTH); King Edward River, old RCA campsite, 1 km S of track to Old Mitchell River Station, Jun 1988, *Edinger 598* (PERTH); 6 miles [*c.* 9.6 km] S of Wyndham, in 1969, *Mackenzie 690316-32* (CANB); 1 km W of Cotton Ginnery, Kununurra, Mar 1979, *Andrew 418* (DNA); new Cockatoo sand site, CSIRO Kununurra, Jul 1978, *Andrew 60* (DNA); Kununurra, Apr 1971, *Black 17* (PERTH); near Lily Creek, 1 km E of Kununurra, Mar 1978, *Paijmans 2341* (CANB); Mirima NP (W of Park entrance gate), Dec 1999, *Handasyde TH99 478* (PERTH); 5 km N of Kununurra, Jan 1979, *Petheram (AAM)260* (DNA, PERTH); vicinity of Kimberley Research Station, Kununurra, in 1969, *Mackenzie 690312-25* (CANB); 8 km S of Kununurra, Mar 1978, *Paijmans 2398* (CANB); 24 km NE of Dunham River Homestead, Mar 1978, *Lazarides 8530* (BRI, CANB, DNA, PERTH); Meda – Oobagooma Road, 59 km by road N of Gibb River Road, Jun 1976, *Beauglehole ACB52705* (PERTH). **Northern Territory.** Spirit Hills, Apr 1998, *Harwood & Brocklehurst 418* (DNA); *ditto loc.*, Apr 1998, *Harwood & Brocklehurst 420* (DNA).

***Distribution and habitat*:** This species occurs in north-western Australia from near Derby, Western Australia to Spirit Hills Wilderness Conservation area (near the W.A./N.T. border), Northern Territory (**Map** 1). It grows in savannah woodlands on sandy soils.

***Affinities*:** *Bonamia fruticosa* is similar to *B. pannosa* (R.Br.) Hallier f. and *B. multiflora* R.W.Johnson. It differs from both species by having larger capsules, seeds and anthers.

Fig. 1. Holotype of ***Bonamia fruticosa*** [*Hartley 14759* (CANB)].

Table 1. Comparison of some morphological characters between *Bonamia fruticosa*, *B. multiflora* and *B. pannosa*

Character	*B. fruticosa*	*B. multiflora*	*B. pannosa*
Outer sepal shape; size (mm); length:breadth ratio	narrowly ovate to ovate or elliptic; 8–14 × 4.3–8; 1.2–2.2	ovate, broadly ovate to deltoid; 8–14 × 2.5–6; 2.1–4.4	very broadly ovate to deltoid; (7–)9–12 × (4–)7–10; 1–1.8
Anther length (mm)	2.1–2.8	1.4–1.8	1.1–1.8
Capsule size (mm)	7–8 × 6–7.5	4.5–6.5 × 3–5	4–5.5 × 3.7–4.5
Seed size (mm)	4–4.6 × 2.9–3.5	2.6–3.8 × 2–2.9	2.4–3.3 × 1.8 –2.5

Bonamia fruticosa also has relatively broader outer sepals than *B. multiflora*. These differences are summarized in **Table 1**. *Bonamia fruticosa* has a much more robust shrubby habit and semi-woody stems that are much tougher than the more herbaceous stems of *B. pannosa*.

***Conservation status*:** *Bonamia fruticosa* is widely distributed in the Kimberley, Western Australia and is not considered to be threatened.

***Etymology*:** The specific epithet is from the Latin *fruticosus*, shrubby, referring to the habit of this species.

2. Bonamia longipilosa R.W.Johnson **sp. nov.**, similis *B. mediae* et *B. brevifoliae* autem ambobus habitu compactiore internodiis brevioribus differt et pilos longiores in foliis caulibusque gerit. *Bonamia brevifolia* vestimento sine pilis semi-appressis in caulibus et pagina inferior foliorum differt. **Typus:** Queensland. Burke District: on track between Musselbrook Mining Camp (175 km N of Camooweal) and Musselbrook Gorge, 30 April 1995, *M.B. Thomas & R.W. Johnson MRS659* (holo: BRI; iso: DNA, MEL).

Bonamia sp. (Lawn Hill R.J.Cumming 17533); Johnson (2007: 51, 2010: 46).

Perennial with short trailing stems from a central taproot; **stems** slender, sparsely to moderately densely hairy; hairs biramous with ascending arms, mainly 0.8–2 mm long. **Leaves** simple, petiolate, crowded with short internodes; **petiole** 1–4 mm long, 0.1–0.3 times as long as the blade; **blade** ovate to broadly ovate, 6–17 mm long, 4–13 mm wide, length:breadth ratio 1–1.6, apex obtuse, mucronulate, base broadly cuneate to rounded or subcordate; with a midrib and 2 or 3 pairs of secondary veins; moderately densely hairy on both sides becoming sparse, hairs with arms mainly 0.8–2 mm long. **Inflorescence** axillary, cymose, with 1–2 flowers; **peduncle** ±absent; **bracts** opposite, linear to narrowly obovate, acute, 3.5–5 mm long, 0.4–0.8 mm wide, persistent; **pedicel** 0.5–2(–4) mm long. **Outer sepals** narrowly ovate, ovate, to ovate elliptic, slightly asymmetric, 6–8 mm long, 2.5–3 mm wide, length:breadth 2.2–2.7, apex acute, base rounded to truncate, moderately dense to densely hairy, hairs with arms 0.3–1.3 mm long; **inner sepals** ovate, 4.5–6.5 mm long, 1.5–2.5 mm wide, length:breadth 2.5–3.3, apex acute to acuminate, base rounded to truncate, hairy along the medial line with a glabrous hyaline margin at the base. **Corolla** funnel-shaped, 7–10 mm long, 10–14 mm diameter, blue; **petals** 10–12 mm long, 6–7 mm across at the limb, distally rounded, emarginate, midpetaline bands hairy for 3–6 mm from the tip. **Stamens** 5; filaments unequal in length, adnate for 2.5–3 mm from the base of corolla tube, free for 3.5–5.5 mm, fused-base winged with scattered hairs and tubercles mainly on the margin and extending above the point of attachment; **anthers** oblong to elliptic, 1.2–1.4 mm long, apex emarginate, base sagittate, basal lobes 0.4–0.6 mm long. **Ovary** globular-ovoid, on a small disk, 2-locular, 0.8–1 mm long, glabrous, except for long hairs towards the tip; **styles** 2, unequal, 6–8 mm long, connate in the lower *c.* 3 mm, glabrous, each with a subglobose-capitate stigma. **Capsule** globular-ovoid, 4–4.5 mm long, 3.5–4 mm diameter, circumscissile,

Fig 2. Seeds of ***Bonamia*** species, ventral and lateral view. **A. *B. fruticosa*** [*Mackenzie 690312-25* (CANB)], **B. *B. longipilosa*** [*McDonald KRM2286 & Covacevich* (BRI)], **C. *B. multiflora*** [*Johnson & Thomas MRS910* (BRI)], **D. *B. pilbarensis*** [*Mitchell PRP217* (BRI)], **E. *B. toniae*** (*McDonald KRM7704 & Covacevich* (BRI)], **F. *B. wilsoniae*** [*Wilson 5231* (NSW)]. Scale bars = 1 mm.

4–8-valved, with some hairs at the apex; **seeds** 2.2–2.8 mm long, 1.5–2 mm across, glabrous, granular, mid-brown to black, wingless. **Figs. 2B, 4, 5D–G**.

***Additional selected specimens (from 28 examined)*: Northern Territory.** *c.* 40 km NW of Kalkaringi, Apr 2012, *Lewis 1984* (BRI). **Queensland**. Burke District: 11 Mile Creek, Normanton – Karumba Road, Mar 2001, *McDonald KRM770* (BRI) [atypical]; Melville Creek, 10 km N of Normanton, Jan 2005, *McDonald KRM3435* (BRI) [atypical]; Normanton – Burketown Road, Jan 2001, *McDonald KRM693* (BRI); 9 km from Normanton on Croydon Road, Apr 1999, *Milson 1465* (BRI); 3 km along Croydon Road, 8 km SSW of Normanton, Apr 1993, *Purvis & Milson IP13* (BRI); *c.* 11 km from Normanton towards Croydon, Apr 2004, *McDonald KRM2264 & Covacevich* (BRI); Normanton, May 1935, *Blake 9168* (BRI); 23 km S of Normanton on Cloncurry – Normanton Road, Mar 1977, *Schmid AS139* (BRI); 27.7 km along Burke Development Road from junction with Croydon – Normanton Road, May 2004, *McDonald KRM2286 & Covacevich* (BRI); Haydon Creek between Croydon & Normanton, Apr 2008, *McDonald KRM7588* (BRI) [atypical]; Burketown – Normanton Road, 16 miles [26 km] E of Wernadinga Homestead, Oct 1968, *Williams 194* (BRI); 79.2 km by road W of Georgetown on E flank of Gregory Range, Mar 2006, *McDonald KRM4946* (BRI); 200 m along Richmond Road from junction with Georgetown – Croydon Road, Apr 2004, *McDonald KRM2237 & Covacevich* (BRI); 9.1 km by road W of Gilbert River Road crossing, Gregory Range, Jan 2005, *McDonald KRM3401* (BRI); 7.5 km by road E of Croydon Post Office, Jan 2005, *McDonald KRM3406* (BRI); 41.9 km E of Croydon near Maitland Creek on Gregory Range, Feb 2006, *McDonald KRM4831* (BRI); Bang Bang jump-up, 103 km from junction of Croydon – Normanton Road, May 2004, *McDonald KRM2295 & Covacevich* (BRI); 17.6 km on Augustus Downs Road from junction at Burke Development Road, Apr 2008, *McDonald KRM7615* (BRI); 28.2 km S by road from Musselbrook Mining Camp on road to Camooweal, Apr 1995, *Thomas & Johnson MRS427* (BRI); 30 km SW of Lawn Hill Gorge on Norfolk – Highland Plains Road, Jun 1998, *Cumming 17533* (BRI); 9.5 km by road to Julia Creek from junction with Burke Development Road, Mar 2005, *McDonald KRM4072* (BRI).

***Distribution and habitat*:** The species occurs near Kalkaringi, Northern Territory and in north-west Queensland, south of the Gulf of Carpentaria, from the Musselbrook – Lawn Hill area to the east of Normanton, towards the Gregory Range (**Map 2**). It grows on alluvial plains and low rises, occasionally on sandstone and lateritic plateaux. It is commonly found on sandy soils, often skeletal and stony, supporting eucalypt, *Acacia* and mixed species woodlands and open woodlands, often with a shrubby understorey.

***Phenology*:** Flowers have been recorded from January to May, also in October, with fruits more common from April to June.

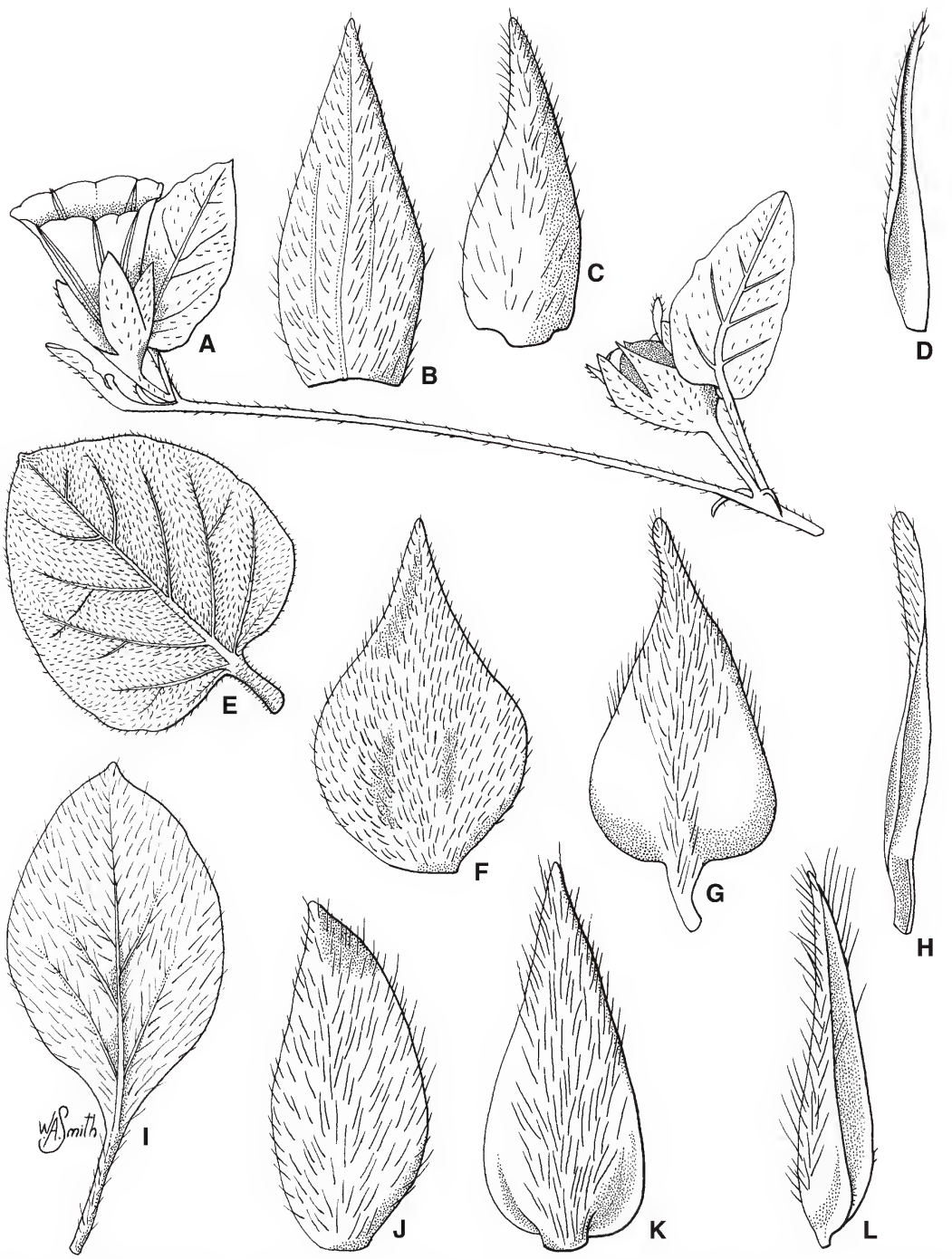

Fig. 3. ***Bonamia wilsoniae*** A. flowering branchlet ×3. B. outer sepal at flowering (abaxial view) ×8. C. inner sepal at flowering (abaxial view) ×8. D. inner sepal at flowering (lateral view) ×8. ***B. fruticosa*** E. leaf ×1. F. outer sepal at flowering (abaxial view) ×4. G. inner sepal at flowering (abaxial view) ×6. H. inner sepal at flowering (lateral view) ×6. ***B. pilbarensis*** I. leaf ×3. J. outer sepal at flowering (abaxial view) ×8. K. inner sepal at flowering (abaxial view) ×8. L. inner sepal at flowering (lateral view) ×8. A–D from *Wilson 4792* (NSW); E–H from *Paijmans 2341* (CANB); I–L from *Long VL1494 09* (PERTH). Del. W. Smith.

Fig. 4. Representative specimen of ***Bonamia longipilosa*** [*McDonald KRM2237 & Covacevich* (BRI)].

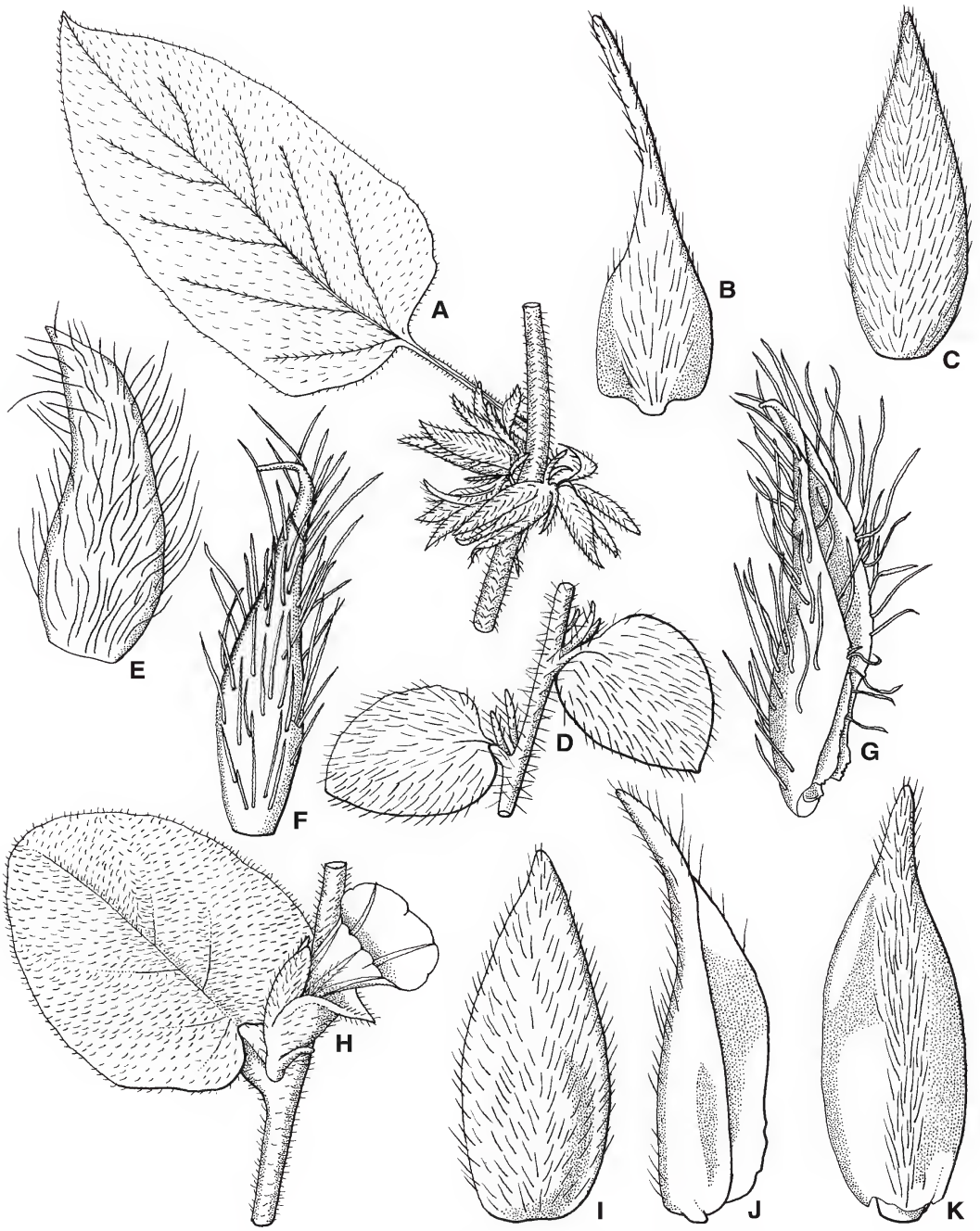

Fig. 5. ***Bonamia multiflora*** A. portion of branchlet with immature fruits ×1.5. B. inner sepal at flowering (abaxial view) ×8. C. outer sepals at flowering (abaxial view) ×4. ***B. longipilosa*** D. branchlet ×3. E. outer sepal at flowering (abaxial view) ×8. F. inner sepal at flowering (abaxial view) ×12. G. inner sepal at flowering (lateral view) ×12. ***B. toniae*** H. flowering branchlet ×3. I. outer sepal at flowering (abaxial view) ×8. J. inner sepal at flowering (lateral view) ×12. K. inner sepal at flowering (abaxial view) ×12. A–C from *McDonald KRM 1089* (BRI); D from *McDonald KRM2237 & Covacevich* (BRI), E–G from *McDonald KRM4946* (BRI); H–K from *McDonald KRM14100* (BRI). Del. W. Smith.

***Affinities*:** *Bonamia longipilosa* is similar to *B. media* (R.Br.) Hallier f., and *B. brevifolia* (Benth.) Myint. It differs from both species in having a more compact habit with shorter internodes and bears much longer hairs on leaves and stems. *Bonamia longipilosa* differs from *B. brevifolia* in vestiture, without the moderately dense cover of semi-appressed hairs on the stems under underside of leaves.

***Conservation Status*:** *Bonamia longipilosa* is widely distributed in north-western Queensland and is not considered to be threatened.

***Etymology*:** The specific epithet is from the Latin *longus*, long, and *pilosus*, pilose, referring to the long hairs on the leaves and stems.

3. Bonamia multiflora R.W.Johnson, **sp. nov.**, arte affinis *B. pannosae* et in ea includa in herbariis et in revisione (Myint & Ward 1968). *Bonamia pannosa* prostrata ramis serpentibus et floribus exterioribus latissime ovatis usque deltoideis, ex contrario *B. multiflora* plus semi-erecta demum decumbens et sepalis exterioribus anguste ovatis ellipticisve ≤ 6 mm latis. *Bonamia multiflora* habitu similari *B. fruticosum* autem capsulis seminibus antherisque minoribus differt. **Typus:** Queensland. Burke District: 27 km by road, NE of Musselbrook Mining Camp, 175 km N of Camooweal, 30 April 1995, *M.B. Thomas & R.W. Johnson MRS639* (holo: BRI; iso: DNA, MEL).

Bonamia sp. (Musselbrook M.B.Thomas+ MRS639); Johnson (2007: 51, 2010: 46).

Bonamia sp. (Chillagoe K.R.McDonald KRM334); Johnson (2007: 51, 2010: 46).

Perennial with erect, tufted stems to 0.7 m, becoming procumbent and trailing or stems prostrate radiating from a central taproot; **stems** densely hairy, often pannose, grey-green; hairs biramous with ascending arms 0.2–1.5 mm long. **Leaves** simple, petiolate; **petiole** 2–22 mm long, 0.1–0.6 times as long as the blade; **blade** ovate to broadly ovate, ovate-oblong, ovate-elliptic or elliptic to broadly elliptic, 20–65 mm long, 7.5–40 mm wide, length:breadth ratio 1.3–4, apex obtuse, acute or acuminate, mucronulate, base rounded to almost truncate, subcordate or cuneate to obtuse; midrib and 4–5 secondary veins usually distinct on lower surface; densely hairy to pannose on both sides, hairs with ascending arms 0.5–1.3 mm long. **Inflorescence** axillary, cymose, with 2–8 flowers; **peduncle** 1–5 mm long or ±absent; **bracts** opposite, linear to linear-obovate, 4–14 mm long, 0.4–1.6 mm wide, acute, persistent; **pedicel** up to 2 mm long or ±absent. **Outer sepals** narrowly ovate to ovate or elliptic, 8–14 mm long, 2.5–6 mm wide, length:breadth ratio 2.1–4.4, slightly longer and broader in fruit, acute or slightly acuminate at the apex, tapering at the base, densely hairy or pannose with hairs arms to 1 mm long; **inner sepals** narrowly ovate to narrowly triangular, 6–10 mm long, 1.6–3.8 mm wide, length:breadth ratio 2–3.8, slightly larger in fruit, apex acute or long acuminate, rounded-truncate to subcordate at the base, densely hairy along the medial line, with a hyaline margin at the base. **Corolla** funnel-shaped or urceolate, 7–10 mm long, 9–17 mm diameter, white, pale blue to purple; **petals** 8–15 mm long, 4.5–9 mm across at the limb, rounded, emarginate, apiculate, midpetaline bands hairy for 4–8 mm from the tip. **Stamens** 5, filaments unequal in length, adnate for 1.5–4 mm from the base of the corolla tube, free for 2.8–6.5 mm, fused-base winged with scattered tubercles mainly on the margin and longer hairs to 0.3 mm long about the point of attachment; **anthers** oblong to ovate-oblong or oblong-elliptic, 1.4–1.8 mm long, apex rounded, emarginate, base sagittate, basal lobes blunt, 0.4–0.6 mm long. **Ovary** cylindrical, on a small disk, 2-locular, 1.5–2 mm long, hairy mainly in the upper half; **styles** 2, unequal, 4–9 mm long, connate in the lower 2–3.8 mm, glabrous, each with a subglobose-capitate stigma. **Capsule** globular-ovoid, 4.5–6.5 mm long, 3–5 mm diameter, circumscissile and 4-valved, with a persistent style base and a tuft of erect hairs at the apex; **seeds** 2.6–3.8 mm long, 2–2.9 mm across, glabrous, finely and uniformly tuberculate, red-brown to dark brown or black, wingless or with narrow thick wing, to 0.1 mm wide, slightly paler than seed surface,

Fig. 6. Representative specimen of ***Bonamia multiflora*** [*Bean 23733* (BRI)].

on one or both margins. **Figs. 2C, 5A–C, 6.**

Additional selected specimens (from c. 120 examined). **Northern Territory.** Kabulwarnamyo O/S, upper Liverpool River, Arnhem Land, Apr 2003, *Russell-Smith 10650* (DNA); headwaters of the Cadell River, *c.* 82 km SSE of Maningrida, Apr 2000, *Cowie 8844* (DNA); 10 km N of Jim Jim Falls, May 1980, *Craven 6074* (CANB); *c.* 7 miles [*c.* 11.2 km] NE of El Sharana Mine, Feb 1973, *Lazarides 7865* (CANB, DNA); Kakadu NP, Birdie Creek, Apr 1990, *Cowie & Leach 1097* (BRI); Limmen NP, turnoff to Limmen River Store and fishing camp, Apr 2008, *Dixon 1792* (DNA); Lorella Station, Jun 1986, *Wilson 16* (DNA); 10 miles [*c.* 16 km] W Borroloola, Jun 1971, *Henry 056* (BRI); 15 km S of Elliott, Jan 1993, *Egan 1334* (BRI); Border Waterhole, Jul 1971, *Latz 1632* (BRI). **Queensland.** Cook District: Dixie Station, SW of Musgrave, Jul 2008, *McDonald KRM7777* (BRI); 28.7 km by road from Chillagoe on Walsh River road, Rookwood Creek catchment, Mar 2004, *McDonald KRM1851* (BRI); between Burke Development Road junction & Gingerella on Mt Surprise road, Mar 2005, *McDonald KRM3681 et al.* (BRI); Newcastle Range, 46.6 km by road to Abingdon Downs from Gulf Development Road, Jan 2008, *McDonald KRM7197* (BRI); 'Mount Surprise', Elizabeth Creek area, off Six Mile Road, Apr 1992, *Champion 672A* (BRI). Burke District: 64 km East of Burketown on Wernadinga Station, May 2003, *Thompson & Newton BUR099* (BRI); Murray Springs, 12.1 km W by road of Musselbrook Mining Camp, May 1995, *Johnson & Thomas MRS910* (BRI); just N of Musselbrook Mining Camp near old dam, May 1995, *Thomas & Johnson MRS971* (BRI); Border Waterhole, Highland Plains Station, Jul 1992, *McDonald KM1089 & Johnson* (BRI); Middle Park, N of Richmond, Jun 1999, *Bean 14974* (BRI); 34 km from Camooweal, towards Mt Isa, May 2005, *Bean 23733* (BRI); Lady Loretta Road, 65 km NE of Mt Isa, Apr 1998, *Barrs SB211* (BRI); Upper Stone-axe Creek, 25 km N of Mt Isa, May 1989, *Harris 391* (BRI).

***Distribution and habitat*:** The species occurs from Pine Creek and Kakadu NP, Northern Territory to the southern parts of the Gulf of Carpentaria and east to the Great Dividing Range from west of Cooktown, south to southwest of Chillagoe and west of Ayr, Queensland (**Map 1**). It is found on sandstone escarpments to rocky rises and granitic hills and tablelands, and associated creek flats. It grows in open *Eucalyptus* woodlands, especially *Eucalyptus leucophloia* low open woodlands with *Acacia* and *Triodia*, and in *Acacia* woodlands, especially *A. shirleyi*. It is found on stony and gravelly sandy soils from deep to skeletal, mainly derived from sandstone or granite.

***Phenology*:** Flowers recorded from December to July, with fruiting occurring mainly April to July.

***Affinities*:** *Bonamia multiflora* is closely related to *B. pannosa* and has been included under *B. pannosa* in herbaria and in the revision of Myint & Ward (1968). *Bonamia pannosa* is usually a prostrate plant with trailing branches. *Bonamia multiflora* has a more semi-erect stature becoming decumbent with age. The shape of the outer sepals is markedly different with *B. pannosa* having very broad ovate to deltoid outer sepals usually greater than 7 mm in breadth whereas *B. multiflora* has narrowly ovate to ovate or elliptic outer sepals ≤6 mm wide. *Bonamia multiflora* also resembles *B. fruticosa* with a similar habit but differs from that by having smaller capsules, seeds and anthers. These differences are summarized in **Table 1**.

***Conservation Status*:** *Bonamia multiflora* is a widespread species and not known to be threatened.

***Etymology*:** The specific epithet refers to many-flowered inflorescences of this species.

4. Bonamia pilbarensis R.W.Johnson **sp. nov.**, quoad semina alis angustis praedita *B. alatisemini* similis autem foliis late ellipticis vel orbicularibus in ambitu et petiolis longioribus a hac differt. Ea olim cum *B. media* confusa autem seminibus alatis distinguenda. **Typus:** Western Australia. *c.* 40 km S of Dampier on Hamersley Iron Railway Line Road, 1 Apr 1995, *A.A. Mitchell PRP217* (holo: BRI; iso: PERTH *n.v.*).

Bonamia sp. Dampier (A.A.Mitchell PRP217); Western Australian Herbarium (2012).

Perennial plant with trailing stems; stems slender, moderately to densely hairy; hairs biramous with ascending arms; arms 0.5–1 mm long, occasionally longer. **Leaves** simple, petiolate; **petiole** 4–12 mm long, 0.3–0.7 times as long as the blade; **blade** elliptic to broadly elliptic or ±orbicular, 7–23 mm long, 5–16 mm wide, length:breadth ratio 1.1–2, apex barely acute to rounded, mucronulate, base attenuate to rounded; midrib and 3–4 pairs of secondary veins distinct on

lower surface; moderately to densely hairy. **Inflorescence** axillary, 1-flowered; **peduncle** to 0.5 mm or absent; **bracts** linear or narrowly oblanceolate, acute, 1.5–3 mm long, 0.1–0.3 mm wide persistent; **pedicel** terete or slightly dilated distally, 1–10 mm long. **Outer sepals** ovate, slightly asymmetric, 5.5–8 mm long, 2.5–3.5 mm wide, length:breadth ratio 2.2–2.5, slightly longer and broader in fruit, acute to shortly acuminate, obtuse to rounded at the base, moderately dense to densely hairy, hairs with arms mainly 0.3–1.1 mm long; **inner sepals** narrowly ovate, 6.5–8.5 mm long, 2–3.2 mm wide, length:breadth ratio 2.5–3.4, apex acute to acuminate, base rounded to sub-cordate, hairy along the medial line with a hyaline margin at the base. **Corolla** funnel-shaped, 10–25 mm long, 12–25 mm diameter, blue to bluish-purple, rarely white; **petals** 11–28 mm long, 9–14 mm across at the limb, distally rounded, depressed, mucronulate, midpetaline bands hairy for 5–8 mm from the tip. **Stamens** 5; filaments unequal in length, adnate for 2–4.7 mm from the base of the corolla tube, free for 2.5–5.5 mm, fused-base winged with scattered hairs and tubercles mainly on the margin and hairs to 0.5 mm about the point of attachment; **anthers** ovate-oblong to oblong, 1.1–1.5 mm long, apex emarginate, base sagittate, basal lobes blunt, 0.2–0.6 mm long. **Ovary** ellipsoidal, on a small disk, 2 locular, 1–1.3 mm long, glabrous, except for long hairs at the base of the style; **styles** 2, unequal, 4.7–7.5 mm long, connate in the lower 1.5–4 mm, glabrous, each with a subglobose-capitate stigma. **Capsule** globular-ovoid, 4–5.5 mm tall, 4–5 mm across, glabrous or with some hairs at the apex; **seeds** 2.3–3.5 mm long, 1.7–2.6 mm across, finely punctate, glabrous, mid-brown to black, with a distinct undulate wing along margins; wing paler than seed surface, 0.2–0.4 mm wide. **Figs. 2D, 3I–L, 7.**

***Additional specimens examined*: Western Australia**. site 4, further S along track S of Deep Gully, SW of Hearson Cove, Mar 2009, *Long VL1494 09* (PERTH); Rear Burrup, Apr 1982, *Glennon 137* (PERTH); Burrup Peninsula, Jul 1981, *Blackwell BP87* (PERTH); Epic Energy LNG lateral pipeline to Wodgina mine, *c.* 100 km W of Port Hedland, S of North West Highway, Apr 2001, *Coultas 21-6* (PERTH); *ditto loc.*, Apr 2001, *Coultas 30-3* (PERTH); *c.* 40 km S of Dampier on Hamersley Iron Railway line road, Apr 1995, *Mitchell PRP217* (BRI); Wallareenya Station, *c.* 80 km due S of Port Hedland, Sep 2006, *Halford Q9165* (BRI); Wogina [Wodgina] Road, 90 km S of Port Hedland, Sep 2008, *Carroll 4* (PERTH); Marble Bar, *s.dat.*, *Groves 8* (PERTH); 1.2 km SW of Coongan River crossing, near Marble Bar, Apr 2006, *Bean 25195* (BRI, PERTH); 6 km NW of Panawonica [Pannawonica] Hill, Panawonica [Pannawonica] Road, Mar 1984, *Newbey 9900* (BRI); *c.* 43 km W of Mt Florence homestead on N margin of Fortescue plain, Sep 1995, *Mitchell PRP781* (BRI, PERTH); back road to gorges, Karijini [formerly Hamersley Range] NP, Jul 1980, *Atkins & Wurm HI-728* (PERTH); Karijini [formerly Hamersley Range] NP, Jan 1985, *Cunningham 6* (PERTH); Yandicoogina, Sep 1980, *Gibbons 73* (PERTH); about 85 miles [*c.* 137 km] S of Munjina Roadhouse on Newman Road on site 121, Sep 1995, *Yan PRP637* (BRI); Paraburdoo Flats, Paraburdoo, Feb 1979, *Atkins 379* (PERTH); Nanjilgardy Pool, E of Paraburdoo, Apr 1985, *Mattiske EMCH1620* (PERTH); 3.7 km E of Mt Channar, 8.2 km NNW of Snowy Mountain, 42.2 km SE of Paraburdoo, Turee Creek Station, Jun 2006, *van Leeuwen et al. PBS0396* (PERTH); 6 km SE of Ashburton Downs, Sep 1979, *Toelken 6350* (BRI, PERTH).

***Distribution and habitat*:** *Bonamia pilbarensis* occurs in the Pilbara Region of Western Australia from around Karratha, south to Ashburton Downs and east to the Marble Bar area (**Map 1**). It grows in *Spinifex* grassland, often with scattered eucalypts and acacias, on stony undulating country, often of basaltic origin, in stony clay to clay loam soils.

***Phenology*:** Flowers have been recorded in January, April and September, with fruit in April, July and September.

***Affinities*:** *Bonamia pilbarensis* is similar to *B. alatisemina* R.W.Johnson in having seeds with a narrow wing. It differs from *B. alatisemina* in having leaves elliptic to broadly elliptic or ±orbicular in outline and longer petioles. *Bonamia pilbarensis* has been previously confused with *B. media* but is clearly distinguished from it by having wing seeds. These differences are summarized in **Table 2**.

***Notes*:** The typical form of this species has a moderately dense indumentum of ferruginous hairs on the stems and leaves with the subtending surfaces visible giving the plants a green to bluey-green appearance. A variant occurring from just south of Port Hedland to the Marble Bar area has a denser indumentum

Table 2. Comparison of some morphological characters between *Bonamia pilbarensis*, *B. alatisemina* and *B. media*.

Character	*B. pilbarensis*	*B. alatisemina*	*B. media*
Petiole length (mm) petiole:leaf blade ratio	5–10 0.3–0.7	0.5–1.5 0.01–0.04	2–8(–11) 0.1–0.3
Leaf blade shape	elliptic to broadly elliptic or ±orbicular	linear to very narrowly ovate	variable in shape mostly ovate, elliptic-ovate, oblong-ovate, ovate-lanceolate
Seeds	winged	winged	wingless

of white hairs giving the plants a silvery appearance (e.g. *Halford Q9165* (BRI); *Bean 25195* (BRI, PERTH); *Groves 8* (PERTH); *Coultas 21-6*, & *30-3* (PERTH); *Carroll 4* (PERTH)).

***Conservation Status*:** *Bonamia pilbarensis* is a widespread species in the Pilbara, Western Australia and not known to be threatened.

***Etymology*:** The specific epithet refers to the region in Western Australia in which it grows.

5. Bonamia toniae R.W.Johnson **sp. nov.**, quoad vestimentum formaque foliorum *B. brevifoliae* similis autem seminibus distincte alatis secedenda. **Typus:** Queensland. Cook District: Normanby Range, Battlecamp Road, NW of Cooktown, 23 April 2013, *K.R. McDonald KRM14100* (holo: BRI [2 sheets], iso: CANB, DNA, K, MEL, *distribuendi*).

Perennial plant with slender trailing branches; **branches** moderately to densely hairy, green; hairs biramous with spreading to erect arms 0.2–1 mm long. **Leaves** simple, petiolate; **petiole** 3–8 mm long, 0.2–0.5 times as long as blade; **blade** discolorous, ovate to broadly ovate, 10–28 mm long, 8–22 mm wide, length:breadth ratio 1–1.9, apex obtuse to rounded, apiculate, base cordate; with a midrib and 3–5 pair of secondary veins usually distinct on lower surface; upper surface green, moderately hairy, glabrescent, hairs with ascending arms 0.2–0.7 mm long; lower surface silvery brown, densely hairy, hairs with appressed to ascending arms 0.1–0.4 mm long rarely longer. **Inflorescence** axillary, cymose, 1–(2–3)-flowered; **peduncle** ±absent up to 0.5 mm long; **bracts** linear, 1–4 mm long, *c.* 0.3 mm wide, moderately hairy, persistent; **pedicels** 2–5 mm long. **Outer sepals** ovate, 5.9–6.5 mm long, 2.6–2.8 mm wide, slightly longer and broader in fruit, length:breadth ratio 2.1–2.3, acute, obtuse at the base, densely hairy; **inner sepals** ovate, 5–5.6 mm long, 2.5–3 mm wide, slightly larger in fruit, length:breadth ratio 1.7–2, acute or acuminate, truncate to sub-cordate at the base, densely hairy along spine and tip with a hyaline basal margin. **Corolla** funnel-shaped, *c.* 5 mm long, *c.* 9 mm diameter, cream with pale yellowish centre; **petals** *c.* 9 mm long and 5 mm wide at limb, rounded, emarginate, apiculate; mid-petaline bands hairy for *c.* 5 mm from tip. **Stamens** 5; filaments unequal in length, adnate for *c.* 2 mm from base of corolla tube, free for 3.8–4.1 mm, fused-base winged, with tubercles and hairs to 0.05 mm long above and below the point of attachment; **anthers** oblong, 1.4–1.5 mm long 0.7–0.8 mm wide, rounded, emarginate at the apex, sagittate, with blunt basal lobes *c.* 0.5 mm long. **Ovary** oblong-globular, on a small disk, 2-locular, *c.* 1.2 mm long, densely hairy with erect hairs mainly confined to the upper half; **styles** 2, unequal in length, 4.5–5 mm long, connate in the lower *c.* 2.5 mm, glabrous, each with a sub-globose capitate stigma. **Capsule** ovoid, 5–7 mm long, 4.5–5 mm diameter, with a tuft of erect hairs to 1 mm long at the tip, circumscissile and 4-valved; **seeds** 3–3.5 mm long, 1.8–2.3 mm across, glabrous, finely punctate, light brown to yellow brown, with a narrow undulate wing along one or both margins; wing slightly paler than seed surface, up to 0.1 mm wide. **Figs. 2E, 5H–K, 8.**

ex ~ WESTERN AUSTRALIAN HERBARIUM, PERTH
Voucher for Pilbara Ranges Project
Bonamia aff.pannosa
Prostrate creeping herb with blue flowers growing up to 0.05m tall Common
Burnt hard spinifex hummock grassland
Skeletal soil on basalt slope
Location : About 40 km. S of Dampier on Hamersley Iron Railway line road
Lat. 21°01'35"S Long. 116°42'12"E
Coll: A.A. Mitchell PRP217 Date: 1st April, 1995
Voucher For : Western Australian Herbarium
Duplicates : BRISBANE PILBARA MITCHELLIANUM
QUEENSLAND HERBARIUM (BRI)
Brisbane Australia
AQ
597364
Queensland Herbarium (BRI)
HOLOTYPE
Bonamia pilbarensis R.W.Johnson
Det. D. Halford (BRI) Date 4th July 2013
Queensland Herbarium (BRI)
Bonamia media var villosa (Benth.) Mgint
Det. Date 22 Nov 1995
Queensland Herbarium (BRI)
Bonamia sp. (Dampier, A.A. Mitchell PRP217)
Det. 23 Jul 2003
Date
0 1 2 3 4 5 6 7 8 9 10
cm
copyright reserved
BRI
QUEENSLAND HERBARIUM

Fig. 7. Holotype of ***Bonamia pilbarensis*** [*Mitchell PRP217* (BRI)].

***Additional specimens examined*: Queensland**. Cook District: Harkness Station, W of Dixie, Jul 2008, *McDonald KRM7807 & Wannan* (BRI); Battlecamp Road, W of Hopevale, Normanby Range, May 2008, *McDonald KRM7704 & Covacevich* (BRI); Fairview – Kimba Road, 18 km W of Peninsula Development road, Apr 1980, *Johnson 4025* (BRI).

***Distribution and habitat*:** Known from three locations on Cape York Peninsula, north Queensland, Harkness Station (W of Dixie), on the Fairview – Kimba Road W of the Peninsula Development road, and in the Normanby Range (W of Hopevale) (**Map 2**). It grows on alluvial flats and creeklines in eucalypt woodland on sandy soils.

***Phenology*:** Flowers have been recorded in April, with fruits from April and July.

***Affinities*:** *Bonamia toniae* is similar to *B. brevifolia* in vestiture and leaf shape, but differs from that by having distinctly winged seeds.

***Conservation Status*:** *Bonamia toniae* is known from three localities in southern parts of Cape York Peninsula. There is insufficient data on population sizes and area of extent to assess the species conservation status.

***Etymology*:** Named in honour of my wife, Toni Johnson.

6. Bonamia wilsoniae R.W.Johnson **sp. nov.**, similis *B. mediae* speciei per Australiam borealem late extendenti autem colore longitudine diametrique corollorum: albae 5–10 mm longae 15–17 mm diam. (vice albae rare cyaneae 8–11 mm longa 6–8 mm diam. in *B. media*) majore ratione petiolo/lamina folii (0.35–0.55 vice 0.1–0.3 in *B. media*) habitu generatim graciliore ab eam differt. **Typus:** Northern Territory. Darwin and Gulf Region: UDP Falls [Gunlom Falls], Waterfall Creek Nature Park [now part of Kakadu National Park], 9 May 1983, *K.L. Wilson 5231* (holo: BRI; iso: DNA, NSW, *distribuendi*).

Perennial with trailing stems from a slender taproot, **stems** slender, moderate to sparsely hairy; hairs biramous with decumbent to ascending arms, arms 0.1–0.5 mm long. **Leaves** simple, petiolate; **petiole** 2–14 mm long, 0.35–0.55 times as long as the blade; **blade** ovate, oblong-ovate to orbicular, 3–33 mm long, 4–18 mm wide, length:breadth ratio 1.5–2.5, apex acute to rounded, mucronulate, base truncate to sub-cordate; midrib and 3–5 pairs of secondary veins distinct on lower surface; sparsely to moderately densely hairy on both sides, hairs with decumbent to ascending arms 0.1–0.5 mm long. **Inflorescence** axillary, cymose with 1 (rarely 2) flowers; **peduncle** ±absent; **bracts** opposite, narrow linear, 1–2 mm long, 0.1–0.2 mm wide, persistent; **pedicel** 1.5–5 mm long. **Outer sepals** ovate, 4.5–6.3 mm long, 2–2.7 mm wide, length:breadth ratio 2–2.7, apex acute, base rounded to truncate, moderately hairy, hairs with arms 0.25–0.5 mm long; **inner sepals** narrowly ovate, 4–6 mm long, 2–2.4 mm wide, length:breadth ratio 2.5–2.6, apex somewhat acuminate, base sub-cordate, hairy along the medial line with a glabrous, hyaline margin at the base. **Corolla** funnel-shaped, 5–10 mm long, 6–8 mm diameter, blue with a white throat; **petals** 7.5–11 mm long, 3.5–4.5 mm across at the limb, distally rounded, emarginate, midpetaline bands hairy for 4–7.5 mm from the tip. **Stamens** 5; filaments unequal in length, adnate for 1.2–1.7 mm from the base of the corolla tube, free for 2–4 mm, fused-base winged with scattered hairs and tubercles mainly on the margin and extending above the point of attachment; **anthers** ovate-oblong to oblong-elliptic, 1–1.25 mm long, apex emarginate, base sagittate, basal lobes 0.4–0.5 mm long. **Ovary** ovoid, on a small disk, 2-locular, *c.* 1.2 mm long, glabrous, except for long hairs towards the tip; **styles** 2, unequal, 3–6 mm long, connate in the lower 2–3 mm, glabrous, each with a subglobose-capitate stigma. **Capsule** globular-ovoid, 4–4.5 mm long, 3.5–4 mm diameter, circumscissile, 4–8-valved, with some hairs at the apex; **seeds** 2.2–2.8 mm long, 1.5–2 mm across, glabrous, granular, mid-brown to black, wingless. **Figs. 2F, 3A–D, 9**.

***Additional specimens examined*: Western Australia.** Hidden Valley, 2.5 km NNE of Kununurra, Apr 1983, *Wilson 4792* (NSW). **Northern Territory.** Victoria River Region: Gregory NP, 100 km SSW of Bullita Ranger Station; on Midnight Creek, Apr 1996, *Foreman & Duretto 2151* (DNA, MEL); Spirit Hills Conservation Area, Nancys Gorge, Aug 1996, *Cowie 7158* (DNA). Darwin and Gulf Region: Fitzmaurice River, upper catchment, May 1994, *Dunlop & Barritt 10063* (DNA);

Fig. 8. Holotype of ***Bonamia toniae*** [*McDonald 14100* (BRI)].

Macadam Range, Feb 1994, *Leach 4195* (DNA); Nitmiluk NP, Mar 2001, *Michell 3352* (DNA); Edith Falls, Apr 1995, *Egan 4743* (DNA).

***Distribution and habitat*:** It is known from the southern part of Kakadu NP, south to Gregory NP extending into Western Australia near Kununurra (**Map 2**). It grows in broken sandstone country on rocky soils in shaded areas beside creeks.

***Phenology*:** Flowers and fruit have been recorded in April and May.

***Affinities*:** *Bonamia wilsoniae* is morphologically similar to *B. media*, a widespread species throughout northern Australia. It differs from *B. media* in having blue corollas which are generally smaller in length and diameter, (5–10 mm long, 6–8 mm diameter versus corolla white or rarely blue, 8–11 mm long, 15–17 mm diameter for *B. media*), a larger petiole to leaf blade ratio (0.35–0.55 versus 0.1–0.3 for *B. media*), and generally a more slender habit.

***Conservation Status*:** *Bonamia wilsoniae* appears to be a rare species, growing in specialised habitats but its conservation status is unknown.

***Etymology*:** Named in honour of Karen Louise Wilson, (1950–) who collected the type and whose extensive collections of Convolvulaceae have greatly assisted me in my studies.

Acknowledgements

I appreciate the continuing support provided by Gordon Guymer, Director of BRI. I thank Will Smith (BRI) for the maps and illustrations, Hans Dillewaard and Jenny Calway for their technical assistance, Peter Bostock for the photograph of *B. fruticosa*, Les Pedley for translating the diagnoses into Latin and David Halford for his contributions while preparing the account for the *Flora of Australia*.

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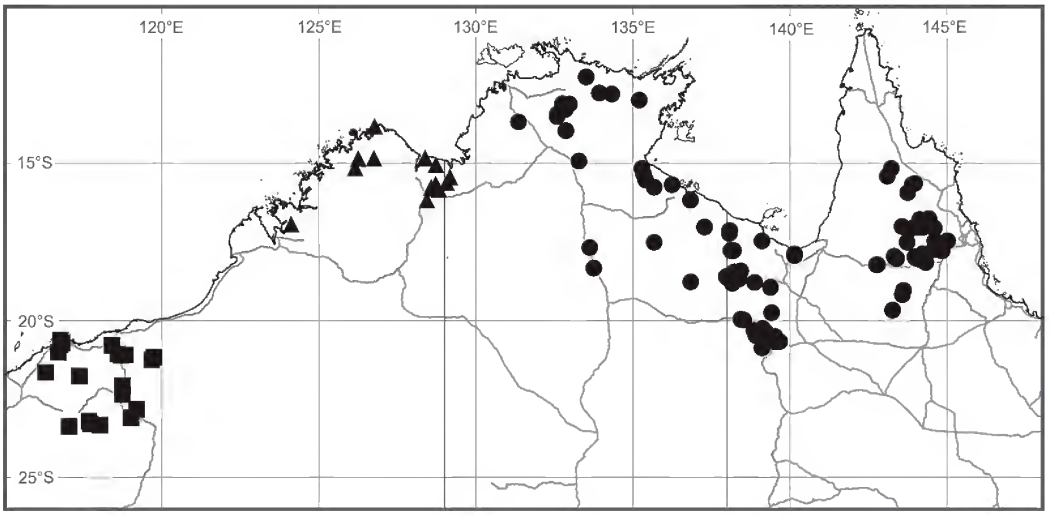
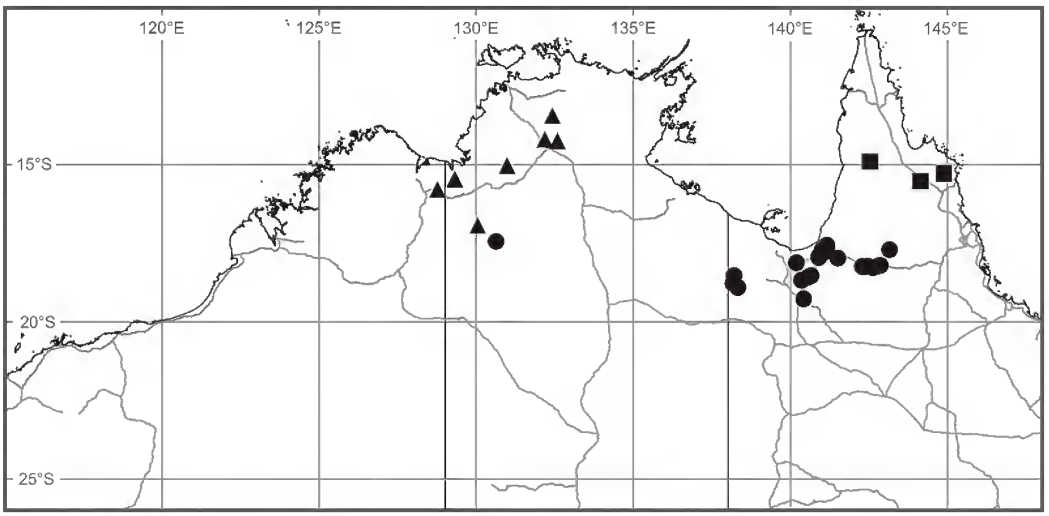
Fig. 9. Representative specimen of ***Bonamia wilsoniae*** [*Egan 4743* (DNA)].



Map 1. Distribution of *Bonamia fruticosa* ▲, *B. multiflora* ● and *B. pilbarensis* ■.



Map 2. Distribution of *Bonamia longipilosa* ●, *B. toniae* ■ and *B. wilsoniae* ▲.

Pluchea tenuis A.R.Bean (Asteraceae: *Plucheinae*), a new species from Cape York Peninsula, Queensland

A.R. Bean

Summary

Bean, A.R. (2014). *Pluchea tenuis* A.R.Bean (Asteraceae: *Plucheinae*), a new species from Cape York Peninsula, Queensland. ***Austrobaileya* 9(2): 311–313**. *Pluchea tenuis* A.R.Bean is newly described and illustrated. It is known from just one locality on Cape York Peninsula where it is associated with mound springs.

Key Words: Asteraceae, *Pluchea*, *Pluchea tenuis*, Queensland flora, taxonomy, new species, mound springs

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Introduction

The genus *Pluchea* Cass. is distributed worldwide and has about 60 species. A revision of the Australian species was published by Hunger (1997). Since then, several additional species have been discovered, described and named (Bean 2011, 2013; Albrecht & Bean 2014). The species described here, *Pluchea tenuis* A.R.Bean, was first collected in 2008, and is currently known only from the type locality on Cape York Peninsula.

Materials and methods

The species description is based on an examination of herbarium specimens at BRI. All measurements were made from dried material.

Taxonomy

Pluchea tenuis A.R.Bean **sp. nov.** affinis *P. rubelliflorae* (F.Muell.) B.L.Rob. sed absentia caulium alatorum, foliis teretibus, flosculis discoideis et femineis albis, flosculis discoideis 50–80 et achenis e flosculis exterioribus femineis solum exorientibus, differens. **Typus:** Queensland. Cook District: Crosbie mound springs, 5 km south-west of Crosbie infrastructure, 5 September 2013, *S. Thompson ST13469* (holo: BRI; iso: CANB, CNS, DNA, K, *distribuendi*).

Accepted for publication 23 September 2014

Perennial shrub to 50 cm high. Stems scrambling to spreading, well-branched, glabrous throughout; not winged. Leaves sessile, linear, filiform, spreading, not decurrent, 15–38 × 0.5–0.7 mm, 30–50 times longer than broad, margins entire, apex acute; glabrous, glands absent. Capitula hemispherical, 5–6 × 9–10 mm, in loose terminal panicles; peduncles 13–42 mm long. Involucral bracts in several rows; outer bracts narrowly ovate, 2–3 × 0.4–0.6 mm, with apex acute, outer surface glabrous, margins entire and glabrous; median bracts lanceolate, 3.5–4.4 × 0.5–0.6 mm, apex attenuate, outer surface glabrous, margins glabrous; inner bracts linear, 4–4.2 × 0.3–0.4 mm, apex attenuate, outer surface glabrous, margins glabrous, entire. Receptacle epaleate, verrucose, glabrous, flat, 2.2–3.4 mm diameter. Marginal florets 80–120, female; corolla filiform throughout, 2.4–2.7 mm long, white; lobes 3, equal, triangular, 0.1–0.15 mm long, glabrous; style bifid, exserted, glabrous; pappus bristles 8–11, 2.2–2.5 mm long, caducous, in a single whorl, coherent at base, all of similar length; barbellate throughout. Disc florets 50–80, white, ovary fully developed but infertile; corolla cylindrical, 2.5–3.2 mm long, white; lobes 5, triangular, 0.4–0.5 mm long, glabrous; anthers *c.* 1.7 mm long, including tail *c.* 0.4 mm long; style undivided, with obtuse sweeping hairs extending below the furcation; pappus

bristles 6–9, 2.4–2.8 mm long, caducous, in a single whorl, coherent at base; barbellate throughout. Achenes developing only from outer florets; narrowly-ellipsoidal, 0.8–0.9 mm long, brown, with sparse appressed twin hairs; surface obscurely longitudinally ribbed; carpopodium prominent, white. **Fig. 1.**

***Additional specimen examined*:** Queensland. Cook District: Crosby Station, 1.6 km W of station homestead, Jul 2008, *McDonald KRM7798 & Wannan* (BRI, NSW).

***Distribution and habitat*:** *Pluchea tenuis* is known only from the type locality, about 90 km SW of Musgrave, Cape York Peninsula. The habitat is a treeless area featuring numerous mound springs, where in places scattered plants of the *Pluchea* occur on grey sandy clay. Nearby, at the edge of the habitat, there are stands of *Melaleuca acacioides* F.Muell.

***Phenology*:** Flowers and fruits are recorded from July and September.

***Affinities*:** *Pluchea tenuis* is morphologically closest to *P. rubelliflora*, but it differs by the terete leaves 0.5–0.7 mm wide (versus flat leaves >2 mm wide), stems not winged (versus stems winged at least near the leaf bases), infertile achenes on the disc florets (versus all florets producing fertile achenes), the 50–80 disc florets (versus 5–30), the white florets (versus pink), and the achenes 0.8–0.9 mm long (versus 0.6–0.8 mm).

***Conservation status*:** *Pluchea tenuis* is known from a population of "a few hundred plants" (S. Thompson, *pers. comm.* April 2014). It is confined to a specialised 'mound spring' habitat where water rich in Sodium salts prevails, and where very few plant species are able to survive. Applying the Red List criteria (IUCN 2001), a conservation status of **Vulnerable** is recommended (Criteria D1, D2).

***Etymology*:** From the Latin *tenuis* – slender or thin. This is in reference to leaves of this species, which are exceptionally narrow in comparison to the other Australian species.

Acknowledgements

I am grateful to Will Smith for producing the illustrations, Peter Bostock for the Latin diagnosis, and Simon Thompson for specimens and information on population size and habitat.

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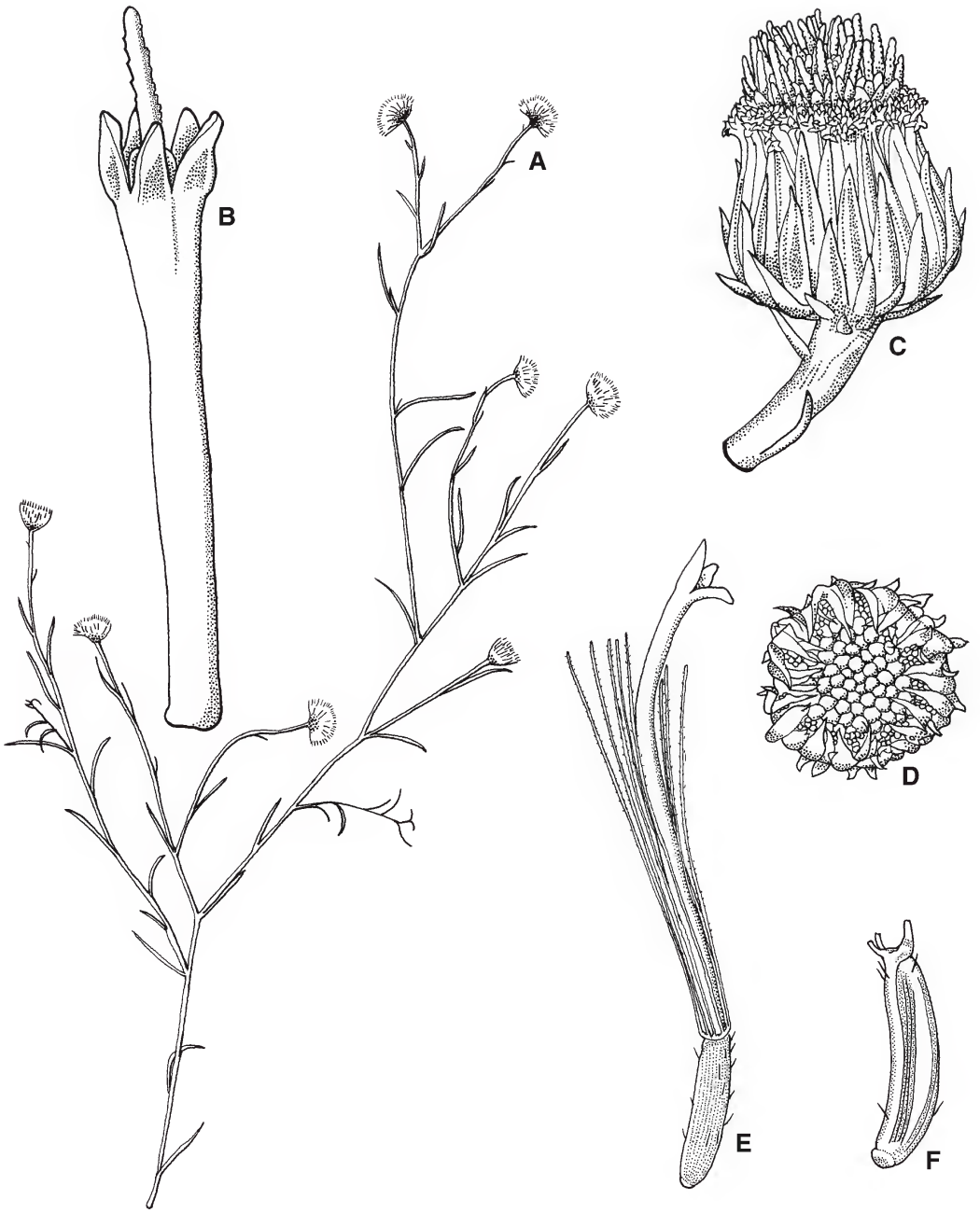

Fig. 1. ***Pluchea tenuis***. A. flowering branchlet ×0.8. B. disc floret ×24. C. flowering capitulum, lateral view ×6. D. capitulum showing the numerous disc florets (corollas not yet opened) surrounded by the smaller marginal florets ×6. E. marginal floret ×24. F. achene ×36. All from *Thompson ST13469* (BRI).

SHORT COMMUNICATION

New combinations for *Senegalia* Raf. and *Vachellia* Wight & Arn. species (Mimosaceae) that occur in Australia

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Senegalia insuavis (Lace) Pedley, **comb. nov.**; *Acacia insuavis* Lace, *Bull. Misc. Inform., Kew* 1915: 401 (1915); *A. pennata* subsp. *insuavis* (Lace) Nielsen, *Adansonia n.s.* 19: 342 (1980); *Senegalia pennata* subsp. *insuavis* (Lace) Maslin, Seiger & Ebinger, *Blumea* 58: 41 (2013). **Type:** Burma [Myanmar]: Ani Sakan, near Maymyo, alt. 3,500 ft. [900m], May 1913, *J.H.Lace 6173* (holo: K; iso: E).

The transfer of *Acacia pennata* subsp. *kerrii* to *Senegalia* by Maslin (2012) left *A. pennata* subsp. *insuavis* in limbo. This was in some way remedied by Maslin *et al.* (2013). However, differential characters given in the protologue of *A. insuavis* and by Nielsen, as well as my own observations, support its being treated as a species. Since Lace was a frequent visitor to herb. Kew and published in its journal I consider that his specimen there to be the holotype. Gamble (1918) wrote "He [Lace] presented a nearly complete set of his collection to the Kew Herbarium, and we are glad to hear his own set has now become the property of the Royal Botanic Garden at Edinburgh".

The species is occasionally grown and may be possibly naturalised in Australia. Lace and recent collectors noted the foetid odour of its crushed branchlets and leaves; this has recently been confirmed by me in examining freshly cut branchlets and leaves.

Vachellia turbata (Pedley) Pedley, **comb. nov.**; *Acacia turbata* Pedley, *Austrobaileya* 6: 180 (2002); *Acacia pallida auct. non* F.Muell. *nec* Willd., Benth., *Fl. Australiensis* 2: 241 (1864); *Acacia pallidifolia* Tindale, *Telopea* 1: 82 (1975), *nom. nov.*, Kodela, *Fl. Austral.* 11A: 199 (2001); *Vachellia pallidifolia* (Tindale) Kodela, *Telopea* 11: 236 (2006), **syn. nov. Type:** Northern Territory. E of Mary River, 29 September 1946, *S.T.Blake 17095* (holo: BRI).

The lectotypification of the name *Acacia pallida* F.Muell. by Tindale (1975) was rejected by Pedley (2002) who described *A. turbata* for the species treated by Mueller. The reasons for the rejection were set out at some length. Though Kodela & Wilson (2006) admitted that Pedley's view had 'merit', they accepted Tindale's and effected the combination *V. pallidifolia* (Tindale) Kodela. They added that a case for the conservation of the name *A. pallidifolia sensu* Tindale was in preparation for submission for consideration by the Committee for Spermatophyta. A ruling by the Committee may clarify the situation and would be welcome, but it seems that the proposal has not been submitted.

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SHORT COMMUNICATION

Lectotypification of F.M.Bailey names in *Conyza* (Asteraceae), *Diplanthera* (Bignoniaceae), *Pygeum* (Rosaceae), *Rhaphidophora* (Araceae) and *Tetracera* (Dilleniaceae) based on E.Cowley collections

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An account of the type collections made by Ebenezer Cowley in north Queensland is given by Dowe (2014). Over 40 new taxa based on Cowley specimens were named by F.M.Bailey and in numerous cases multiple collections were listed that are syntypes for these names. In several instances lectotypification of these names has remained in abeyance or been ignored with incorrect designation of some collections as sole types made by diverse authors. This appears to have been based on a common assumption that the first specimen cited by Bailey was automatically the holotype; however, there is no evidence that this was the case and in the late 1890s when he worked it was common practise to cite multiple specimens, but no actual 'type'.

In this note we discuss typification of these names (none of which are currently recognised) and designate lectotypes to ensure stability of their application thus fulfilling Art. 8.1 of the *International Code of Nomenclature* (McNeill *et al.* 2012), *viz.* "The type (holotype, lectotype, or neotype) of a name of a species or infraspecific taxon is either a single specimen conserved in one herbarium or other collection or institution, or an illustration".

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1. *Rhaphidophora lovellae* F.M.Bailey (Araceae), *Queensland Agric. J.* 1: 453 (1897). **Type citation:** *About 20 miles from Cooktown, Miss Lovell; and ranges about Cairns, E.Cowley.* **Type:** Queensland. Cook District: Near Cooktown, undated, *S.Lovell s.n.* (lecto [here designated]: BRI [AQ333008]).

= **Epipremnum pinnatum** (L.) Engl., *Pflanzenr.* 37: 60 (1908).

***Notes*:** There were two collections mentioned in the protologue, *'Cooktown, Miss Lovell'* and *'ranges about Cairns, E.Cowley'*. Hay (1993, 2011) listed the former as the holotype and made no mention of the second syntype for this name. The specimen (*s. loc.*, undated, *Cowley 31D* (BRI [AQ333006])) was identified as the second syntype for *R. lovellae* by S.T.Blake and D.H.Nicholson in 1961. Nicholson also identified the material as *R. australasica* F.M.Bailey. The Lovell specimen is selected as lectotype.

2. *Conyza elata* F.M.Bailey (Asteraceae), *Bot. Bull. Dept. Agric. Queensland* 8: 78 (1893), *nom. illeg. non* Kunth. & Boucheé. **Type citation:** *Abounding in the scrubs of the Russell River, and attaining the height of 12 or 14 ft., Bellenden-Ker Expedition; Barron River Scrubs. E.Cowley.* **Type:** Queensland. Cook District: Stoney Creek, Barron River, undated, *E.Cowley 72B* (lecto [here designated]: BRI, 2 sheets [AQ370513]; iso: MEL).

= **Blumea riparia** (Blume) DC., *Prodr.* 5: 444 (1836).

***Notes*:** The name *Conyza elata* F.M.Bailey was invalid when published due to it being a later homonym of *C. elata* Kunth. & Boucheé. It has been referred to synonymy under *Blumea riparia* (CHAH 2006–2012), although it was not referred to in the most recent revision of *Blumea* (Randeria 1960).

The two syntypes for *Conyza elata* F.M.Bailey are extant at BRI (AQ370513 and 370511). The Cowley collection is more extensive and the better specimen; hence its designation as the lectotype.

3. *Diplanthera hirsuta* F.M.Bailey (Bignoniaceae), *Bot. Bull. Dept. Agric. Queensland* 14: 11 (1896); *Deplanchea hirsuta* (F.M.Bailey) Steenis, *Recueil Trav. Bot. Neerl.* 920 (1927). **Type citation:** *Stony Creek, Cairns (a shoot and loose flowers), L.J.Nugent. A large leaf and very young shoot gathered on Thursday Island, E.Cowley.* **Type:** Queensland. Cook District: Stoney Creek, undated, *L.J.Nugent s.n.* (lecto [here designated]: BRI [AQ333176]).

= **Deplanchea tetraphylla** (R.Br.) F.Muell., *2nd Syst. Census Austral. Pl.* 167 (1889); CHAH (2006–2012).

***Notes*:** The two syntypes for *Diplanthera hirsuta* are both extant at BRI (AQ333176 & 333178). The Cowley collection is sterile comprising a single large leaf and remnants of a shoot. In comparison the Nugent collection is fertile (remains of some flowers) and comprises an intact shoot with four leaves. As it is the better material, the Nugent collection is selected as lectotype for the name.

4. *Tetracera cowleyana* F.M.Bailey (Dilleniaceae), *Bot. Bull. Dept. Agric. Queensland* 5: 7 (1892). **Type citation:** *Herbert River, H.G.Eaton; Cairns, E.Cowley.* **Type:** Queensland. Cook District: Cairns, undated, *E.Cowley 22* (lecto [here designated]: BRI [AQ341696]).

= **Tetracera nordtiana** var. **moluccana** (Martelli) Hoogland, *Fl. Males. Ser. I*, 4: 145 (1951); Hoogland (1953: 203).

***Notes*:** There are three Cowley specimens in BRI that are of *Tetracera* with two referable to *T. nordtiana* var. *moluccana*. One is labelled as 'Cairns' and the other as 'Barron River'. Hoogland (1953: 201) stated for typification of *T. cowleyana*: "Cowley s.n. Cairns, Queensland (Cook Distr.); holotype in BRI, isotype in MEL"; no mention is made of the Eaton collection (BRI [AQ181060]) although that author annotated the specimen in 1950 as *T. nordtiana* var. *moluccana*. *Cowley 22* (BRI [AQ341696]) was annotated by Hoogland as 'type' and is superior in quality to the other collection; it is designated as lectotype for this name.

5. *Pygeum turnerianum* F.M.Bailey, *Bot. Bull. Dept. Agric. Queensland* 8: 75 (1893). **Type citation:** *For shoot, bearing male flowers, and later branches with ripe fruit, Barron River, E.Cowley. Stones of fruit, Christie Palmerston and A.Meston.* **Type:** Queensland. Cook District: Barron River, 1893, *E.Cowley s.n.* (lecto [here designated]: BRI [AQ317688]; isolecto: BM, K all *n.v.*).

= **Prunus turneriana** (F.M.Bailey) Kalkman, *Blumea* 13: 81 (1965).

***Notes*:** Kalkman (1965) cited "*Cowley s.n.*, holotype probably in BRI (*non vidi*), isotypes seen from BM, K; paratypes: *Palmerston* (*s.n.*?), *Meston* (*s.n.*?), loose fruits probably also in BRI (*non vidi*)" but did not provide details about the specimens. This statement also reinforces the statement that authors in the past have interpreted the first listed collection as the type and subsequent collections as paratypes. Both the Palmerston and Meston fruit collections do not appear to be extant at BRI and the Cowley collection is chosen as lectotype for the name.

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SHORT COMMUNICATION

Aeschynomene micrantha (Poir.) DC. is a synonym of *A. brevifolia* L.f. ex Poir.

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Reynolds (1990) concluded that the closely related *A. micrantha* (Poir.) DC. and *A. brevifolia* L.f. ex Poir. could be distinguished by hair type, stipe length and the length of the petiole + rachis. Examination of many additional specimens since has shown that these characters intergrade with varying densities of long glandular and short curved hairs, and there is no correlation with stipe length or petiole + rachis length, or between these characters. The situation with the type specimens of these two taxa, both from Madagascar is discussed at length by Rudd (1959) who concluded that the two specimens were conspecific and that *A. brevifolia*, the earlier name, should be applied. Therefore the Australian specimens previously identified as *A. micrantha* are correctly named *A. brevifolia* L.f. ex Poir.

The closely related introduced species *Aeschynomene falcata* (Poir.) DC. and *A. brasiliana* (Poir.) DC., are also commonly confused with *A. brevifolia*. The distinguishing characters are given in the key below. *Aeschynomene* species distribution maps are available on Australia's Virtual Herbarium (2014).

Key to the native and naturalised (*) species of *Aeschynomene* L. in Queensland

1 Articles of fruit 10–15 × 7.5–9 mm; flowers 12–18 mm long; stems thick and spongy . . . . . **A. aspera**
1. Articles of fruit less than 7 mm long; flowers less than 10 mm long; stems not as above **2**

2 Leaflets 5–18, obovate to elliptic-oblong and more than 3 mm wide **3**
2. Leaflets 12–112, narrowly oblong or falcate, less than 3 mm wide. **5**

3 Stems covered in spreading glandular hairs; leaflets more than 1 cm long . . ***A. brasiliana**
3. Stems with appressed hairs, not glandular; leaflets less than 1 cm long **4**

4 Fruits falcate, with 6–8 articles; stems mostly fine appressed hairy; stipe 6–14 mm long, with spreading hairs 1–2 mm long. . . . . ***A. falcata**
4. Fruits straight or slightly falcate, with 1–4 articles; stems variously hairy, usually with a mixture of long spreading glandular hairs greater than 1 mm long, and appressed or curved short hairs; stipe 2–7 mm long, glabrous or with spreading hairs but these less than 1 mm long . . . . . **A. brevifolia** (syn. *A. micrantha*)

5 Leaflets with 1 main nerve, not falcate **6**
5. Leaflets with 2 or 3 main nerves, usually falcate **7**

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6 Fruits with straight or slightly curved upper margin, indented between articles on lower margin . . . . . **A. indica**
6. Fruits indented on both margins (moniliform); articles elliptic . . . . . ***A. paniculata**

7 Flowers yellow, 3–5(–9) mm long; fruit villous or hispid, the surface veins and murications obscure; articulation joins less than half of the article width . . . . . ***A. villosa**
7. Flowers purple, 6–8(–10) mm long; fruit glabrous, puberulent or glandular; reticulate veined near margin and muricate; articulation joins more than half the article width **8**

8 Fruit articles and pedicel pubescent with mostly glandular hairs . . . . . ***A. americana** var. **glandulosa**
8. Fruit articles and pedicel glabrous or with few non-glandular hairs . . . . . ***A. americana** var. **americana**

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